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AIMS OF THE JOURNAL "METEOROLOGY AND HYDROLOGY"

Meteorology and Hydrology is designed for a broad circle of readers -- for scientific workers, engineers and technicians working in the fields of meteorology, hydrology and agrometeorology, and also for specialists who are working at problems impossible to solve successfully without a sufficiently profound knowledge of individual points in the realm of these sciences. So large and diverse a circle of readers imposes upon the journal's editorial staff a distinct obligation in selection of materials for publication, both in relation to subject matter and in relation to the form of exposition.

Meteorology and Hydrology will accept articles which may interest a considerable number of readers. It will be required of the authors of these articles, beyond the requirements relating to the subject and content of their works, to present their material clearly and understandably for the majority of readers, but strictly enough so as not to admit excessive popularization and simplification. Scientific works which have been accomplished through the use of complex and specific procedures should be written up in the form of a description of the statement of the research problem and the basic results, with a sufficiently detailed explanation of their physical significance and of methods for practical application of these results.

By selecting and publishing articles on scientific, technical and organizational questions, Meteorology and Hydrology should contribute to the fulfillment of the following aims:

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1. The mobilization of the co-workers in the Hydrometeorological Service and of all persons working in the fields of meteorology, hydrology and agrometeorology for the execution of Party and Government resolutions, principally in departments which are directly related to the above-mentioned fields of science.

2. The struggle for Marxist-Leninist methodology in the solution of problems of meteorology, hydrology and agrometeorology.

3. The struggle against adulation of foreign scientists, against cosmopolitism, the struggle for the priority of Russian and Soviet science.

4. The interchange of experience in setting up and solving scientific problems connected with the hydrometeorological data service to the national economy.

5. Raising the qualifications of specialists working on the periphery and in the central institutions of the Hydrometeorological Service, and also in other departments which utilize hydrometeorological data in their work.

6. Spotlighting the activity of the best hydrometeorological stations, hydrometeorological bureaus, observatories, etc., so as to guarantee that the advanced people in the field will be displayed, to the end that their work experience may be diffused throughout the entire network of hydrometeorological stations.

The first problem is solved through the publication of articles indicating ways and means for execution of Party and Government decrees for specialists of various qualifications in the fields

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of meteorology, hydrology and agrometeorology. The solution of the first problem will also be furthered by the publication of articles citing concrete examples of the actual carrying out of measures originating in Party and Government decrees.

The second problem is solved through publication of articles, for the most part of a critical character, revealing methodological errors in published articles and books. For the solution of this same problem Meteorology and Hydrology proposes to organize a series of discussions on questions related to various fields of the hydrometeorological sciences.

The third problem is solved through publication of articles reestablishing the historical truth concerning native discoveries and inventions and thus proving our priority in science. While exposing falsification in the history of science on the basis of factual material, the articles should at the same time reveal the loss of priority which is connected with cosmopolitism or with the bowing down of certain scientists before foreign scientists.

The fourth problem is solved through publication of articles containing new results, new work methods in one or another field of hydrometeorological science and more efficient forms of service to the national economy. Subsequent discussion of these articles in print will help the reader to understand their content and specific scientific importance more deeply and at the same time broaden the practical possibilities for utilization of the results of this or that author's work.

The fifth problem is solved through publication of articles describing the work of the best hydrometeorological stations and

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bureaus, presenting this work through concrete examples. This same goal will be pursued by descriptions of specific improvements in one or another area of the work of the Hydrometeorological Service and by criticism of the inadequacies of its work as a whole and of the work of its individual sections. Since the solution of this problem is unthinkable without the direct participation of a considerable number of the co-workers of hydrometeorological stations, bureaus, etc., in the journal's work, it is extremely desirable that all remarks on the indicated questions and others which concern the improvement of the work of the Hydrometeorological Service as a whole and of its individual sections be directed by workers on the periphery to the journal's editorial address. For the closest possible relationship between the co-workers of the Hydrometeorological Service and the journal's editorial staff it is also desirable that local administrations of the GMS [Hydrometeorological Service] should conduct, through inspectors, appropriate explanatory work at the stations. The chiefs of network sections and of sections of the forecasting service, understanding the importance of this matter, should give the essential instructions and assignments to the inspectors.

From all that has been said it should be clear that Meteorology and Hydrology has set itself completely definite problems which differ essentially from those solved by the collections of works of science-research institutions or by the Hydrometeorological Service's informational collections.

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MOISTURE CIRCULATION IN THE ATMOSPHERE

K. I. Kashin and
Kh. P. Pogosyan

The moisture circulation in the atmosphere plays an essential role in the formation and distribution of precipitation and consequently in the formation of climate and the distribution of vegetation. At present no sufficiently complete and accurate description exists of the process of moisture circulation and the role of its constituent parts. A considerable number of research works have been devoted to separate components of the moisture balance. To this number belong, first of all, works devoted to flowoff, to the distribution of precipitation and, fragmentarily, to evaporation. To questions of moisture circulation over small areas and over large areas on the order of continents only isolated works have been devoted, and these are marred by inaccurate methods of calculation which lead to incorrect conclusions.

Among such works is that of Professor V. V. Tsinzerling, the results of which were published in brief form in 1948 [5]. We shall dwell below upon this author's basic conclusions and the research methods he employed.

It should be mentioned that in 1947 Zh. D. Zubyan and Kh. P. Pogosyan performed calculations of moisture circulation using methods which are very close to those which we accept. However, these authors solved the problem set before them with application to a small basin situated in complex topographical conditions.

In the present article we propose to investigate the role of evaporation from a continent, over small and large areas, in

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the moisture circulation of the atmosphere.

It is known that the distribution of precipitation over continents is to a considerable degree determined by the moisture which is carried over from the oceans. In analyzing the cause of this or that distribution of precipitation over any continent it is first of all necessary to determine the character of the prevailing circulation over the continent and the oceans which adjoin it. The amount of precipitation on a continent usually decreases in the direction of the prevailing atmospheric transfer. Since the fundamental atmospheric transfer is west-east, the annual quantity of precipitation decreases from west to east; in a group of regions, however, significant deviations from this rule are observed, which are explained principally by the presence of hills and mountains.

In addition, the character of the circulation is an essential factor in the distribution of precipitation. We know that precipitation is determined not only by the moisture content of the air which is transferred horizontally, but also by the vertical movements in which the air masses take part. Naturally, the vertical motions, which bring about cooling of the air and consequently condensation of the water vapor and deposit of precipitation, originate for the most part in the cyclone system. Therefore the predominance of cyclonic or anticyclonic circulation over one or another region plays an extremely essential part in the distribution of precipitation.

For example, in a vast territory of Eastern Europe and Western Siberia the maximum annual quantity of precipitation falls

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in the zone between latitudes 65 and 50 degrees. South of this zone, to a latitude of 40 to 45 degrees, the quantity of precipitation sharply decreases; meanwhile, the moisture content of the air which is transferred over these latitudes is greater than in the zone of maximum precipitation. One should seek the cause of this first of all in the difference of circulation characteristics. The frequency of cyclones in the zone between 65 and 45 degrees northern latitude decreases from north to south [2,3]. The low frequency of cyclones north of 50 degrees northern latitude also contributes to a decrease in the relative humidity of the air transferred from the ocean deep into the continent as a consequence of transformation. In particular, the existence of the deserts of Central Asia is dependent on the peculiarities of the circulation and related transformations of the transferred air masses.

If it originated solely in the moisture content of the air masses transferred from the ocean to the continents and were not affected by circulation characteristics, the distribution of precipitation would be more uniform than it actually is.

West-east transfer in the troposphere is predominant principally in temperate latitudes. In tropical regions in summer the west-east transfer is sharply disrupted, and the fall of precipitations in these regions is determined by that circulation system which to a considerable degree is stipulated by the contrast between the temperatures of ocean and dry land. This factor is manifested especially strongly in southeast Asia, where it conditions both the amount and distribution of precipitation. The emergence of a powerful thermic depression over Southern Asia

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creates the conditions for monsoon activity -- the transfer of air from the Indian Ocean to the mainland. The circulation which is evoked by the presence of the southern Asiatic summer depression encompasses the regions lying south of the primary mountain chain of South Asia. For this reason the transfer of moisture from the Indian Ocean does not directly affect the moisture circulation over the USSR. As for the narrow zone at the extreme east of Asia where there is a large amount of precipitation, it is indebted to the cyclonic circulation which frequently recurs there and thanks to which a transfer of moisture from the neighboring seas is produced.

An accurate solution of the problem of atmospheric moisture circulation may be obtained from analysis of the role of the most important factors -- the constituent parts of the balance. These factors are: (a) the transfer of moisture in the atmosphere, (b) precipitations, (c) flowoff and (d) evaporation. The role of the enumerated factors will naturally differ depending upon the dimensions of the area over which the moisture balance is being determined.

The Quantity of Moisture Transferred in the Atmosphere.

For determination of the quantity of moisture transferred by air masses one cannot limit one's calculations of moisture content solely to the layer of air at the earth's surface. It is known that a cloud involved in the fall of precipitation is located on the average at an altitude of up to four or five kilometers. It is also known that with high relative humidity at the earth's surface

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convective precipitation does not fall if the relative humidity is below 30-40 percent up to an altitude of four to five kilometers. The same applies to the fall of more or less considerable frontal precipitations. It is clear that the formation and fall of precipitation is influenced by the moisture content of the whole column of air to an altitude of at least four to five kilometers. One may suppose that the quantity of moisture contained in the air above five kilometers is extremely small in comparison with the quantity contained in the first five kilometers. This supposition is found to be in agreement with the data of aerological observations. Therefore, in calculations of the quantity of moisture transferred by the air over any territory it is necessary to take into account the whole quantity of moisture which is contained in the column of air from the earth's surface up to an altitude of five kilometers.

An accurate determination of the quantity of moisture transferred by the air for a given time interval may be derived in accordance with daily data of aerological observations of the wind velocity and moisture content of the air over the given region. The overall quantity of moisture transferred in the five-kilometer layer should be calculated as the sum of the moisture transferred by [constituent] layers. With the aid of such a calculation the distribution with respect to altitude of both wind velocity and humidity is taken into account, thus making it possible to determine the overall quantity of transferred moisture with the utmost accuracy.

For clarification of the general picture of moisture circulation a simplified method of calculation may be employed. This

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consists of the determination of the total quantity of moisture in the entire five-kilometer column of air. The calculation is more conveniently performed using specific humidity. In addition the average (with respect to altitude) velocity of the prevailing transfer is calculated, which for practical purposes is replaced by the velocity of transfer at the 700 millibar surface, corresponding to an altitude of approximately three kilometers. Thus the product of the wind velocity and the total moisture content in the air column will give the quantity of moisture transferred in unit time.

Precipitation.

For the moisture balance the quantity of falling precipitation is more conveniently taken not from the data of separate stations but from precipitation charts composed for the time segments in which one is interested.

Flowoff.

It is most expedient to take the magnitude of flowoff summarily by river basins.

Evaporation.

The greatest difficulty is presented by the determination of the evaporation components of the water balance. They may be determined using the approximate data which are obtained from direct observations. At the present moment, however, the methods of these observations are extremely incomplete, and in consequence the results obtained on this basis are very inconsistent: in the same regions

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the magnitude of evaporation according to the data of some authors is often double the magnitude obtained by other authors.

This is why it is more expedient to determine the magnitude of evaporation by proceeding from the water balance of a basin, inasmuch as the rest of the components of this balance may be determined considerably more accurately. One may determine the magnitude of evaporation by this method only in the case when the basin under consideration occupies a large territory and the calculations are conducted using data obtained over many years. It is known in fact that the water which soaks into the soil, participating in the water balance, enters after a certain time interval in the form of the subterranean flow in rivers; in considering a large basin we have the right to suppose that almost all the water which soaks into the soil enters by way of the subterranean flow into the rivers of the same basin. For a small basin, meanwhile, this supposition will not always be sufficiently well founded, since part of this water may run by way of the subterranean channels out of the boundaries of the basin being considered. It should also be noted that considerable time is required for the completion of the run of infiltrated water through the subterranean channels, which in isolated cases may amount to many months.

THE ROLE OF EVAPORATION IN HUMIDIFICATION OF THE ATMOSPHERE

It has already been stated above that as a consequence of the fall of precipitations, moisture transferred from oceans

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gradually decreases in proportion to its advance into the depth of the continent. If all the fallen precipitation were to leave through the flow into the seas and oceans the drying of the air would proceed extremely rapidly and the more rapidly the more the transferred air masses would take part in the cyclonic circulation. As a result of this and with the great expanses of the continents, their eastern regions would as a rule turn out to be dry; that is, almost no precipitation would fall there. In actuality this is not observed since a considerable part of the precipitation falling on a continent is once more returned to the atmosphere as a consequence of evaporation. The evaporating precipitation is transferred greater distances in the presence of anticyclonic type weather. Moreover the length of the path of transfer of moisture from the place of evaporation is affected by the process of warming of the air (withdrawal from saturation) which occurs with greatest intensity in southern latitudes.

It is self-evident that the direct role of evaporation in formation of the precipitation which falls on this same area will differ in relation to the dimensions of the territory. From small territories almost all the evaporating moisture will be carried off by air currents and will add almost nothing to the humidification of the air and the increase of precipitation in this same region. Here a direct influence on the fall of precipitation is exerted by evaporation from territories disposed in a direction contrary to the fundamental transfer of air masses.

Proceeding from the stated conditions, let us present an example of calculation of the components of the moisture balance

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and let us determine the role of evaporation in the supplementary humidification of the air.

CALCULATION OF THE COMPONENTS OF THE WATER BALANCE

As an example for calculation we shall take the Oka basin. The selection of this basin is explained by the fact that it is located in the central lowland section of the USSR's European territory and has been sufficiently illuminated by data of meteorological and hydrological observations. The area of the basin is 244,000 square kilometers, the basin being elongated in a latitudinal direction and being approximately characterized by the following dimensions: 400 kilometers along the meridian and 600 kilometers along the parallel.

The average annual quantity of precipitation in the Oka basin amounts to approximately 550 millimeters, which is equal to 134.2 cubic kilometers.

The flow of the Oka at the Novinka alignment amounts on the average to 33.2 cubic kilometers per year.

Thus the evaporation from the whole basin during a year is equal to 101 cubic kilometers.

Let us investigate what portion of the total quantity of moisture transferred by the air in the course of a year over this territory is attributable to evaporation.

Presented in Table 1 are all the initial data used in calculations of the moisture transferred by the air over the Oka basin, by season and for the year [4].

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TABLE 1

The Quantity of Moisture Contained and Transferred over the Oka Basin and the Average Velocity of Transfer by Seasons

Magnitudes being determined	Spring	Summer	Autumn	Winter	Year
Quantity of water in cubic meters contained in a column of air with altitude five kilometers and base one square kilometer.	8,850	21,770	12,410	4,660	-
Average velocity of transfer, kilometers per hour.	35	25	35	40	-
Total quantity of transferred moisture, cubic kilometers . .	272.5	476.2	382.2	154.0	1275.0

In the calculation it is assumed that the general transfer is west-east. The elongation of the basin coincides with the direction of general transfer. It has already been mentioned above that the small transverse dimension of the basin (400 kilometers) lies perpendicular to the general transfer.

As is shown in Table 1, the total quantity of water transferred by the air over the Oka basin in the course of an entire year amounts to 1275.0 cubic kilometers. Let us calculate what part of this quantity of water is made up of precipitation, flow and evaporation. Proceeding from

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the data presented above on precipitation, flow and evaporation, we obtain the result that of the water transferred by the air in the course of the entire year, precipitation constitutes 10.5 percent, flow 2.6 percent and evaporation 7.9 percent.

From these data it is apparent that even for a basin of relatively large dimensions, precipitation, flow and evaporation constitute a small magnitude in relation to the entire amount of water which is transferred by the air in the course of the whole year. Hence one may conclude that evaporation from the earth's surface may play a substantial role in the humidification of the moving air only if it originates from very large areas. Judging from the results we have obtained, evaporation amounts to 7.9 percent for a shift of the air masses by a distance equal to the length of the basin (600 kilometers). This is the quantity of water which is returned to the air after the fall of precipitation. Naturally the role of evaporation increases in direct proportion to the distance traversed by the air mass.

It is not without interest to apply our method of calculation of moisture circulation to a more vast territory in order to obtain data on the components of the moisture balance and to determine the role of each component in this balance. To serve as such a territory we have taken the European part of the USSR.

In determining the quantity of moisture which is transferred by the air over the European territory of the USSR we have considered it expedient to calculate this quantity of moisture through a cross-section (in relation to the west-east transfer) which would satisfy the set problem; as such a section we have

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selected an imaginary wall five kilometers high along the meridian 25 degrees eastern longitude between 68 and 43 degrees northern latitude. We have used the data of aerological observations of the humidity of the air for the last year and have averaged them by seasons. The season is taken as the unit of time because both the atmospheric circulation and the moisture content of the air essentially change from season to season, but remain the same in general features within a season. In addition, determination of the humidity along the latitudes shows that for calculation it is expedient to divide the wall we have selected into two parts; a northern section, between latitudes 68 and 53 degrees and a southern section, between latitudes 53 and 43 degrees.

The initial data and the results of calculation of the moisture transferred by the air from the west are presented in Table 2, which shows that in the course of a year, 8,507 cubic kilometers of water are transferred by the air in the European territory USSR.

To determine the role of the components of the moisture balance we have used B. D. Zaykov's data [1].

According to these data the total area of the river basins of the USSR's European territory amounts to approximately 6.5 million square kilometers, and the river flow from it during a year is 928 cubic kilometers.

[See next page for Table 2]

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TABLE 2

The Quantity of Moisture Transferred by the Air over the European Territory of the USSR and the Average Velocity of Transfer by Seasons

Season	Region	Quantity of Moisture (cubic meters) in a column of air five kilometers high with base one square kilometer	Average velocity of transfer in kilometers per hour	Total quantity of moisture transferred, in cubic kilometers
Spring	68 - 53°	7,500	35	974
	53 - 43	11,250	35	854
Summer	68 - 53	16,900	25	1,518
	53 - 43	21,800	20	1,069
Autumn	68 - 53	11,350	35	1,458
	53 - 43	14,400	35	1,236
Winter	68 - 53	5,000	40	736
	53 - 43	6,750	40	662
Year	68 - 43	-	-	8,507

The obtained data show the role of each of the constituents of the moisture balance over such a vast territory as the European part of the USSR.

The average yearly quantity of precipitation on the European territory of the USSR may be taken as 480 millimeters (see V. V.

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Tsinzerling's article), or 3,120 cubic kilometers. Thus 2,192 cubic kilometers of water go into evaporation.

The obtained magnitudes show that of the total moisture transferred by the air in the course of a year precipitation constitutes about 37 percent, flow 11 percent and evaporation 26 percent.

Hence it is apparent that of the enormous quantity of moisture (8,507 cubic kilometers) which is transferred primarily from the west, only 928 cubic kilometers or eleven percent leave by the flow of rivers; the remaining part of the moisture (7,579 cubic kilometers) is transferred beyond the limits of this territory, primarily in an eastern direction. This is, namely, that quantity of moisture which passes through a wall analogous to that we have selected and located along the meridian of the Ural range.

Let us notice that, as follows from Table 2, the moisture content is considerably greater in all seasons over the southern part of the USSR's European territory than in the north. As has been already stated above, this is explained by the difference in the circulations in various regions. Actually the frequency of cyclones decreases sharply from north to south.

Naturally, the enrichment of the air with moisture through evaporation does not proceed uniformly in all seasons. The ratio of evaporation to precipitation changes from month to month. At the end of spring and beginning of summer this ration will be maximum, which is explained by the increase of evaporation due to the drying out of the soil.

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The results of calculation of the components of the moisture balance over the European territory of the USSR are in good agreement with the results obtained for the Oka basin.

As we have already indicated, the extent of the Oka basin from west to east is 600 kilometers. The extent of the European territory of the USSR, measured along the latitude of this basin, is about 2,000 kilometers, that is, 3.3 times greater.

If the data obtained (on precipitation, flow and evaporation) for the Oka basin are multiplied by 3.3, the result almost completely coincides with the magnitudes of the components of the moisture balance calculated for the European territory of the USSR.

For convenience of comparison we bring forward Table 3, which presents the proportions of precipitation, flow, evaporation and quantity of moisture transferred.

TABLE 3

Moisture Balance Components in Percent

Moisture Balance Components	Oka Basin	European Territory USSR
Precipitation	10.5	37.0
Flow	2.6	11.0
Evaporation	7.9	26.0

Thus we have shown that the role of evaporation as a factor in the humidification of the air masses transferred over a dry-land

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surface is relatively small; that is, the quantity of moisture obtained by the air from evaporation from dry land is small in comparison with the [total] moisture transferred over a continent.

In the light of our conclusions let us examine certain statements contained in Academician I. A. Sharov's article, "The Question of Alteration of Agricultural Climate" [6].

The Stalin plan for the transformation of nature encompasses an extremely broad complex of measures directed toward the radical improvement of agriculture and the obtaining of high and stable yields. As is known, the most important elements of this complex are field-protective forest plantings, grassland crop rotation and the construction of reservoirs and tanks. All these measures will produce an increase in the moisture retained by the soil, both in the period of the spring thaw and in the period of the summer rains, and thus will change the character of the flowoff. In addition, the forest plantings will change the wind system by decreasing the velocity of the wind, which conditions a decrease in the scorching action of dry winds, in the blowing away of topsoil layers, etc. The forest plantings and grassland system will lead to a change in the composition of the soil and thus will improve the water permeability of the soil, both in field and forest. The reservoirs and tanks will collect the off-flowing waters in the period of the spring thaw and in periods of summer downpours and will make it possible to produce local irrigation of fields with the most moisture-loving crops.

Consequently these most important measures will produce a decrease of the flow in rivers and will redistribute it within

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the growing season. The increased moisture reserves will lead, by means of evaporation, to a supplementary humidification of the lowest air layers. The decrease of wind velocity due to the presence of forest belts will contribute to the retention of a considerable part of the moisture in the layer of air at the earth's surface. In addition, air temperature will drop somewhat on account of evaporation, which will lead to a certain increase in relative humidity.

This is the important thing which should lead to improvement of the microclimate of the vast steppe and forest-steppe regions of the USSR.

Nevertheless, certain scientists, proceeding from inaccurate data on the atmospheric moisture circulation, do not evaluate the part played by forest plantings with sufficient correctness. We shall touch upon this question here because articles which do not give a correct exposition of the question have appeared in the scientific literature during recent years. We have in mind the mentioned articles of Academician I. A. Sharov and Professor V. V. Tsinzerling, which do not correctly elucidate questions of moisture circulation.

Academician I. A. Sharov, on the basis of Professor V. V. Tsinzerling's data on the so-called external and internal moisture circulations in the atmosphere, comes to the following conclusion: "If in areas bare of forests, with a low grass cover and a small number of reservoirs, the incoming moisture from the ocean now circulates only 2½ times in our territories, and often

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even less, then under the new conditions the internal moisture circulation will probably increase to three times, that is, the average quantity of precipitation during a year will increase from 480 millimeters to approximately 560 to 570 millimeters.

This conclusion is based, as we have indicated, on the data of Professor V. V. Tsinzerling, who maintains that of the moisture transferred over the USSR's European territory and coming in from the Atlantic Ocean, 193 millimeters falls on the average during a year as precipitation ("external precipitations").

"Internal precipitations" according to this account amount to 287 millimeters, which gives a total of 480 millimeters. From this the moisture circulation coefficient of 2.5 is established; in other words, the moisture coming from the ocean must, in V. V. Tsinzerling's opinion, be evaporated 2½ times and fall anew in the form of precipitation on this same territory. The article does not indicate where the 193 millimeters of precipitation which are attributed to "external" (that is to that coming from the oceans and adjacent seas) come from; therefore we cannot analyze the methods of obtaining these values here.

However, our calculations indicate that on the average per year approximately three times as much moisture is carried over the European territory USSR as falls in the form of precipitation on this same territory. The total yearly evaporation, which supplements the stores of atmospheric moisture, here amounts to about 26 percent of the overall quantity of water transferred by the air.

These proportions of magnitude indicate that evaporated moisture, even in so large an area as the European territory USSR,

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is only a small part of the moisture which is transferred from the ocean and the neighboring seas over this territory.

It should be emphasized that the process of turnover of evaporating water is rather complex. Actually, the conditions for intensive evaporation and the conditions for condensation of water vapors with fall of precipitation are completely different. Condensation and fall of precipitation occur, as a rule, during cyclonic circulation, when evaporation is ordinarily being accomplished considerably more slowly. Intensive evaporation, on the other hand, occurs as a rule during the anticyclonic type of circulation, when condensation and fall of precipitation are usually absent. Therefore the moisture which is evaporating most intensively is carried away by the air to distant regions. The fall of moisture in the form of precipitation on the same territory where evaporation has occurred happens only rarely and cannot be a basis for calculation of so-called internal moisture circulation.

Hence it follows that the idea of division of precipitation into external and internal is erroneous, and conclusions based on this idea have no real foundation [literally, "have no real soil under them"]. This also pertains to the conclusions of the above-indicated authors concerning the considerable increase of precipitation in a series of regions due to an increase in the so-called internal moisture circulation.

However, it is impossible to omit the part played by the roughness of the earth's surface in variation of the quantity of falling precipitation. We have already mentioned at the beginning of this article that in spite of the general decrease in quantity of

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precipitation from west to east, the quantity of precipitation in a series of eastern regions is greater than in the western regions. This, as has already been indicated, is to a large degree stipulated by the presence of mountain ranges. But in addition to mountain ranges surface irregularities both in the form of small hills and in the form of forest zones influence the quantity of precipitation.

In G. P. Kalinin's article, "The Part Played by a Forest in the Distribution of Precipitation" (printed in this issue of the journal), this question is sufficiently elucidated, and therefore we shall not analyze it in detail. Let us only note that a forest which is spaced in the form of isolated strips amid fields plays a greater part as a roughness factor in the increase of precipitation than a continuous forest mass. The increase of precipitation induced by these strips is connected, not with increase in precipitation in the forest regions, but with mechanical action on the constitution of the flowoff. This action leads to an increase in the vertical velocity of the air, which in turn proves to be the cause of a certain increase in the quantity of precipitation in regions with forest strips. Materials of observation on precipitation in various regions indicate that low hills and forest strips increase precipitation about one millimeter per meter of elevation.

Of course, there can be no general rule here. The relationship between the increase of precipitation and the elevation of the locality changes substantially depending upon the region. The increase of precipitation with altitude in one or another region

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is connected with the nature of the circulation and with the frequency of fall of precipitation. In regions and seasons characterized by anticyclonic weather the influence of low hills and forest strips is negligibly small and for practical purposes equal to zero. Therefore it is impossible mechanically to carry over G. P. Kalinin's conclusions, which were made on the basis of analysis of materials on Moscow oblast, or our own deliverations on this question to the southern rayons of our country. The latter demand special research in order to obtain the quantitative characteristics of variation of precipitation in relation to increase of forests. However, on the basis of all that has been set forth we may consider it indubitable that the field-protective forest plantings in the southern rayons of the European part of the USSR will induce an increase in the quantity of precipitation as a consequence of the increase in the roughness of the locality.

Further research on this question is completely essential, since it will make it possible to realize more truly the magnificent Stalin plan for the transformation of nature. Paths toward detailed research in concrete physico-geographical regions may be considered to be already laid out.

We will not begin here to touch upon certain other questions which are also dealt with incorrectly in the above-mentioned articles, because they have no direct relation to the problem posed by us.

CONCLUSIONS

1. The quantity of ocean moisture transferred by the air in the course of a year in each region diminishes by a magnitude equal

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to the average yearly river flow in the given region.

2. If it is assumed that the quantity of precipitation falling per year on all the territories of the USSR in the absence of evaporation is equal to the yearly total precipitation over the European territory USSR, then approximately in the region of the Lena basin full desiccation of the air should occur. In actuality this is not so, because the air obtains supplementary humidification on account of evaporation of fallen precipitation.

3. Evaporation from small areas amounts to an extremely small magnitude and cannot play a substantial role in increase of the moisture content of the transferred air, much less in the fall of precipitation. Thus, for example, evaporation from the whole Oka basin (244,000 square kilometers) amounts to less than eight percent of the moisture which is transferred by the air over this territory.

4. Evaporation from reservoirs of relatively small area can play scarcely any part in the supplementary humidification of the atmosphere or alteration of the system of precipitation. Therefore the drainage of large swamp areas has no effect on the change in quantity of falling precipitation.

5. The coefficient of so-called internal moisture circulation in the European territory USSR obtained by Professor V. V. Tsinzerling, equal to 2.5, does not correspond to reality. He has exaggerated by almost seven times.

6. Field-protective forest belts, as a factor in the increase of the roughness of the locality, stipulate a certain increase

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in the quantity of precipitation.

REFERENCES

1. Zaykov, B. D., The Average Flow off and its Distribution per Year in the Territories of the USSR. Trudy NIU GUGMS, number 24, 1946.

2. Pogosyan, Kh. P., Seasonal Fluctuation in the General Atmospheric Circulation. Trudy TsIP, number 1 (28), 1947.

3. Rykachev, M. A., Types of Cyclone Paths in Europe. 1896.

4. Khrgian, A. Kh., The Distribution of Humidity over Moscow. Trudy of the Aerological Observatory, number 1, 1948.

5. Tsinzerling, V. V., Professor, The Internal Water Circulation in the European Territory USSR and its Significance for Water Economy. Doklady, volume II, number 7, 1948.

6. Sharov, I. A., The Question of Alteration of Agricultural Climate. Doklady of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin, number 6, 1949.

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THE PART PLAYED BY A FOREST IN DISTRIBUTION OF PRECIPITATION

G. P. Kalinin

As is known, the distribution of precipitation over the earth's surface is determined by three fundamental factors:

(1) by the moisture content of the air flowing in the lower troposphere (on the order of 5 kilometers) locality;

(2) by the character of the atmospheric circulation;

(3) by the character of the underlying surface.

At the present time man is hardly in a position to alter the first two factors.

But the third factor has already been changed considerably within historical time thanks to man's activity (the felling of forests, drainage of swamps, construction of reservoirs and so on). However, until not long ago such changes bore a local character. Only in our socialistic country, thanks to the realization of the great Stalin plan for the transformation of nature, has the alteration of the underlying surface over vast expanses taken on an active, purposeful character.

It is appropriate to recall the words of A. I. Voyeykov, who, in his work "The Influence of Man Upon Nature", wrote:

"In the question of man's influence upon climate, the matter has been visualized upon too grandiose a scale. Proceeding from the indubitable truth that man can neither influence solar radiation nor change the distribution of the general air

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currents, we have rushed to the conclusion that his influence either does not exist or is extremely negligible, but have not taken into account the fact that the question is of the lower layer of air, whose conditions are to a considerable degree subject to human influence."

The underestimation of man's capacities for transforming nature, so characteristic of western scientists, has also penetrated into the midst of soviet climatologists.

In the present article an attempt is made to determine qualitatively what changes in the system of precipitation may be evoked by field-protective forest plantings.

The moisture content of the air and the character of the atmospheric circulation change very little over distances of several tens of kilometers. At the same time, such an important meteorological element as precipitation is distributed extremely irregularly even in flatland localities. Moreover the variation in quantity of precipitation over extremely short distances, measured in a few kilometers, reaches several tens of percent. It is natural to assume that the cause of this variability in atmospheric precipitation over comparatively short distances is not the variation in large-scale atmospheric processes but variation in the character of the underlying surface.

It is also altogether obvious that the cause of the indicated phenomenon cannot lie in the variability of evaporation over the territory, since, on the one hand, the quantity of evaporating water in a small territory is extremely small in

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comparison with the quantity of moisture transferred over the given territory (as the research of K. I. Kashin and Kh. P. Pogosyan has shown), and, on the other hand, the observed irregularity of evaporation over the territory must be essentially equalized in the process of exchange of air masses. Moreover it is a known fact that there is a decrease in the quantity of precipitation over large reservoirs, in spite of the fact that evaporation from them is considerably greater than from dry-land areas.

The latter may be explained by the fact that over large reservoirs thermal convection is as a rule diminished and dynamic turbulence sharply decreased. The diminution of thermal convection follows from the fact that in the summer period, during daylight hours, the water surface is usually colder than the dry land. The decrease in dynamic turbulence finds its explanation in the fact that the water surface is less irregular than dry land.

Thus both these factors decrease the vertical velocity components of the air motions, which, as is known, are causes of paramount importance in the formation of precipitation.

Hence one may make still another conclusion: any change in the underlying surface which stipulates a considerable increase in the vertical velocity of the air must lead to an increase in precipitation.

The question of the influence of this or that variation in the underlying surface upon variation in the precipitation regime must in the first place be considered as a question of

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variation in vertical atmospheric velocities.

Essential factors influencing the variation of vertical atmospheric velocities are the topography of the locality and solid forest masses. The influence of large hills and mountains on precipitation has been partially studied, whereas the role of small hills and hillocks has not been clarified up to the present time.

Meanwhile the actual distribution of precipitation in a flatland region shows that even relatively small variations in the topography are noticeably reflected in the quantity of falling precipitation, and only this can explain the breaks in the smooth contour of the isolines of multiannual precipitation in woodless regions.

Still less studied is the influence of a forest as a roughness factor intensifying the turbulent exchange directly above it. However, small hills and forest strips may be considered as roughnesses of the same order. Therefore a more detailed examination in a specified territory of even only approximate characteristics of topographical disjunction presents considerable interest.

To serve as such extremely approximate indices of the roughness natural to the earth's surface we have utilized a chart of average inclinations of the surface of the European territory USSR drawn up by S. S. Sobolev in accordance with data on the frequency of erosional disjunction and the depths of local erosion levels. The average inclinations of the surface presented

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on Sobolev's chart reflect the average difference in the altitudes of points of the surface located at distances equal to unity, and therefore may serve as known characteristics.

Comparison of the mentioned chart of surface inclination with the distribution of precipitation over the whole European territory of the Union verifies what has been stated earlier. In regions with a clearly expressed increase in inclination of up to ten percent a clearly expressed increase in precipitation is indeed also observed.

It is not difficult to show similarly that the variation in the vertical disjunction of the earth's surface which is created by forest belts attains the above-mentioned limits and even considerably exceeds them. Let us assume that the forest belts in a large territory are located at distances on the order of 0.5 kilometers from one another. The air current crossing neighboring belts at a distance of 0.5 kilometers will be once lifted and once lowered.

The average additional inclination of such rises and falls of the air (in the lower layer) will be:

$$i_{\text{add'l}} = \frac{2 \triangle h}{L} ,$$

where $\triangle h$ is the height of the forest belt and L is the distance between belts.

If we take $\triangle h = 10$ meters and $L = 0.5$ kilometers, then the average additional inclination due to the presence of forest

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belts will amount to 40 percent.

Such a magnitude of the indirect index of roughness inclination may, according to the considerations cited above, substantially increase the precipitation. Here, however, the question arises as to whether it is correct to apply the same procedure of measurement of vertical disruption of the earth's surface to topographical irregularities, on the one hand, and to field-protective forest belts on the other.

Certainly some strain has been permitted in interpretation. But in everything related to influence on precipitation there exists an indubitable similarity between irregularities in the earth's surface and forest belts. Furthermore, forest belts create a sharper vertical disruption of the surface than irregularities of the earth. Therefore it seems probable that the influence of forest belts is even greater than the influence of protuberances of similar dimensions but smoother outlines.

The question of the influence of a forest on precipitation is many years old and voluminous literature is devoted to it. However, the majority of investigators of this question have occupied themselves, in essence, with the study of the microclimate of a forest. In this way the role of a forest as a factor in the formation of topography and its influence on the system of precipitation have been completely lost from view.

A. I. Voyeykov, citing data on the forest-steppe zone of the European part of the Union, which show a noticeable increase of precipitation (by 12 to 27 percent) in regions where small groves

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exist as compared with woodless sections, noted that the increase in precipitation in the first case is characteristic for all months. However he also assumes that the influence of a vast and thick forest mass on precipitation will be greater than that of isolated forest plantings.

Therefore, in order better to clarify the role of a forest in the general increase in quantity of precipitation we have considered it essential to analyze its influence as a factor creating additional roughness and thermic nonhomogeneity. For this purpose voluminous material with data on precipitation and woodedness of 100 stations located in the territory of the Moscow oblast have been utilized. (For purposes of exclusion of the influence of the city, stations located in Moscow and its environs have not entered into the treatment.) The choice of this region was determined not only by the great density of the meteorological network, but also by the fact that it is located on the border of the forest and forest-steppe zones and consequently considerable diversity in the character of forest distribution is observed here. Inasmuch as the height of a forest may be accepted as a constant magnitude, the influence of the woodedness of a station's locality may be characterized by the sum of the lengths of the contours of all the forest strips located in its locality. We have provisionally considered a circle of radius 30 kilometers (an area of 2,826 square kilometers) to be the characteristic locality for each station. Calculation of the woodedness (the sum of the lengths ΣL of the contours of all the forest strips located in the indicated area of the station's locality) was conducted using a chart with a scale of 1:500,000. For analysis of the influence of the length of the contours of the

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forest masses on the magnitude of the precipitation norms, all the stations were arranged in the order of decreasing length of contour.

In this connection it was discovered that the interruption of the earth's surface by a forest significantly alters the quantity of falling precipitation. Of course a series of other factors (the topography of the locality, position of the forest in relation to moisture-carrying winds, etc.) also strongly influence the readings at individual stations. Therefore, in order to obtain averaged indices of the influence of forest distribution, the precipitation norms and the lengths of forest contour corresponding to them were averaged by fives of stations (rayons) and in accordance with them the function (Figure 1) illustrating the influence of forest distribution on precipitation was plotted. Near the points of this function the values of the inclination of the locality, whose influence may be traced rather clearly, were also plotted.

Differentiation of dynamic and thermal effects is extremely important. Materials for the latter may be obtained using rayons with excess humidification, where thermal homogeneity is relatively low.

In Figure 1 it is apparent that the influence of a forest attains substantial proportions for large values of $\sum L$. It should be noted that in the cited result the increase of precipitation as a consequence of forestation is undoubtedly assisted by the effect of the general climatic differences between the northwestern and southeastern rayons of the Moscow oblast. It is difficult to distinguish this climatic effect on the figure; however, one glance at it suffices to judge that this effect can in no case

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nullify the influence of forestation. It is probable that a similar influence of forestation on precipitation may be also found in the more southern oblasts of the USSR. There this influence will possibly be less, in connection with the different type of circulation and the greater dryness of the air.

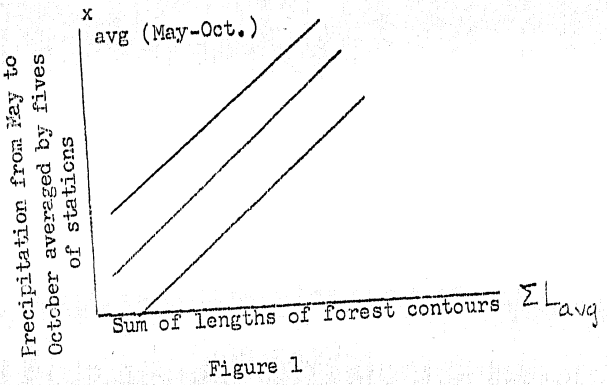
x
avg (May-Oct.)
Precipitation from May to October averaged by fives of stations
Sum of lengths of forest contours
ΣL_{avg}

Figure 1

Figure 1 gives only a qualitative representation of the nature of influence of the lengths of forest contours on precipitation. Its utilization for calculation of the possible variation in quantity of precipitation would lead to some exaggeration of the part played by a forest, since the general climatic difference between the northwestern and southeastern rayons of the Moscow oblast have not been taken into account here.

Therefore the corresponding functions of annual precipitation were subjected to additional analysis by seasons (November-April and May-October).

For construction of these the precipitation was averaged by fives of stations, the stations being arranged in order of the

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decrease in argument ΣL. Here there appeared the extremely curious circumstance that the precipitation during the cold period for the available range of ΣL (1300 square kilometers) was increased on the average by 8 to 10 percent, the annual precipitation by about 15 percent and the precipitation during the warm part of the year by about 20 percent. This circumstance testifies first of all to the fact that inaccuracies of measurement of precipitation caused by the blowing off [of precipitation] from the rain gages impair the relationships. With further analysis we satisfied ourselves in a series of additional processings that the influence of the additional roughness created by forest contours on winter precipitation is somewhat less than on summer precipitation. This may be explained by the above-indicated cause and also by the decrease during the winter months of the part played by deciduous forests as a factor interrupting the natural structure of the air flow.

The figures obtained above on the part played by a forest are too high on account of the incomplete calculation of the parallelism between the decreases of woodedness and of precipitation toward the southeast.

For elimination of this factor a series of calculations were conducted, the principal ones amounting to the following:

(a) elimination of the geographical factory by way of reduction to one isohyet;

(b) introduction of a correction, for Moscow oblast, for the altitude of the locality, which is, as is known, an indirect characteristic of the relief.

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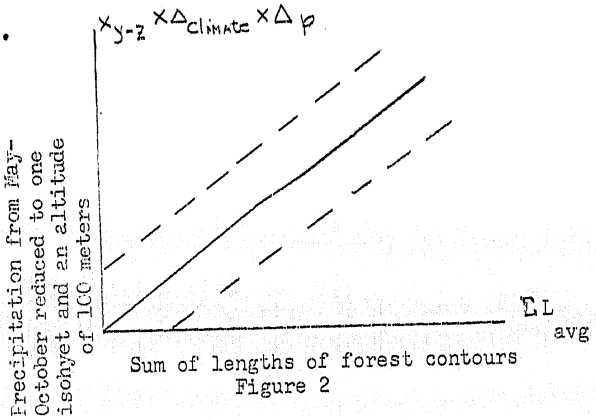
The precipitations thus corrected were averaged for each group of five stations according to the criterion of maximum nearness of the values of the sums of lengths of forest contours to one another (Figure 2).

Apparent in Figure 2 is the general tendency toward increase of precipitation, amounting to about ten percent for the range of characteristics of forest contours (1400 kilometers) available in this rayon.


$x_{y-z} \times \Delta_{climate} \times \Delta p$
Precipitation from May-October reduced to one isohyet and an altitude of 100 meters
ΣL_{avg}
Sum of lengths of forest contours
Figure 2

Since elimination of the influence of climatic factors and topography by this method is to a certain extent conditional, an attempt was made to solve the problem of elimination of general climatic effects and other factors which disturb the conformity to law by another method.

In order to make such a determination objective, one must apply a somewhat provisional but standard scheme. It proceeds from the fact that to compare the change of precipitation of stations located close together in connection with the change in the index of woodedness does not seem possible, since the accepted characteristic of woodedness reflects the conditions of formation of precipitation in closely neighboring stations. On the other hand,

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in analysis of the difference of precipitation between stations located far from one another it would be difficult to exclude the influence of climatic conditions. Therefore for each station the difference in precipitation was calculated in relation to stations located at a distance of approximately 100 kilometers. For each station the difference was calculated in relation to three stations located at the indicated distance. In this manner 300 differences in magnitudes of precipitation were obtained for the rayons of Moscow oblast. The corresponding difference in magnitude of lengths of forest contours was also calculated for these stations. Then the average precipitation was correspondingly calculated for cases of difference in lengths of contour $>$ 400, from 400 to 301, from 300 to 201 . . . $<$ 400. The data plotted on Figure 3 represent the results obtained using the indicated 300 differences in precipitation. The figure shows that for the observed range of fluctuation in lengths of forest contour the increase in precipitation in Moscow oblast amounts to 12 to 13 percent.

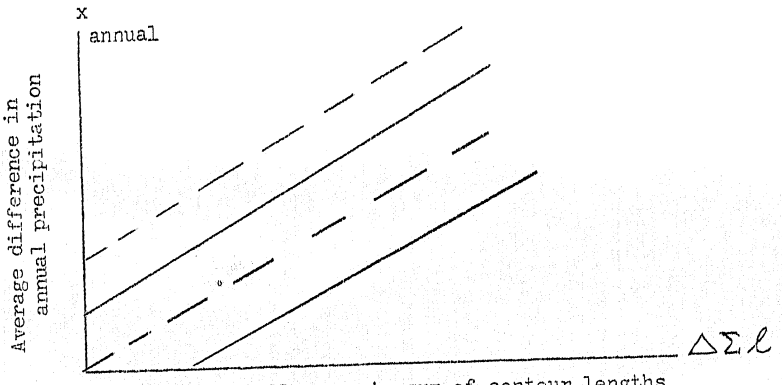

Figure 3

1 - southwest; 2 - Moscow oblast

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In order to be satisfied with the justness of the obtained results for the region southwest of Moscow oblast, analogous work was conducted in the Smolensk-Kiev direction; the results of this work are also presented in Figure 3. It is apparent from the latter that for the southwestern region, as one ought to expect, the change in precipitation proves to be somewhat less; however, in percentage proportions it remains the same and amounts to 12 to 13 percent. After the present work was examined in the Central Forecasting Institute it was referred to the Main Geophysical Observatory where an extensive and labor-consuming check of the obtained conclusions was made using mass material.

Elimination of the climatic effect on the basis of calculation of the climatic and physicogeographic conditions by way of reduction of the summer precipitation to one region was also accomplished in the GGO [Main Geophysical Observatory] (by O. A. Drozdov). For this purpose the territory under consideration was divided into six uniform regions. According to the existing difference in summer precipitation norms for uniform lengths of forest contours, they were reduced to one region. These calculations also allow one to conclude that for the summer period in Moscow oblast the average increase of precipitation for the available range of lengths of forest contour (1400 kilometers) is equal to 40 to 45 millimeters, which amounts to 10 to 13 percent of the total quantity of precipitation.

On the basis of the mass processing of hydrometeorological materials which was carried out, it may be considered to be established that the various combinations of forests already exist-

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ing at present in natural conditions can give an increase in precipitation of up to ten percent, the maximum increase occurring in regions characterized by maximum lengths of contours.

It follows from the performed analysis that the Stalin plan for the transformation of nature requires for its realization a supplemental humidification of the forest-steppe and steppe regions owing to the increase in atmospheric precipitation.

To perform an accurate quantitative calculation of the change in quantity of precipitation owing to the increase in surface roughness and thermal nonhomogeneity created by field-protective forest belts does not yet seem possible, since there is still not sufficient experimental and theoretical data, and nothing analogous to such a grandiose plan exists in history.

Nevertheless, the research which has been conducted provides a foundation for determination of degrees of increase of precipitation.

Lengths reckoned according to small-scale maps are, we know, seriously underestimated. Comparison of the lengths of forest contours measured according to these maps indicates that these lengths are about twice too small. Measurements by charts of larger scale would come nearer to the actual values of the computed lengths. Within the limits of accuracy of calculation one may consider the lengths of forest contours in the areas we selected as characteristic for a station to be approximately three times greater than those we obtained; consequently their limiting magnitude for the cases we have analyzed would amount to

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about 4,000 kilometers.

If we assume that in areas under agricultural cultivation the distance between [forest] belts will be on the average 0.5 kilometers (transverse) and 1.2 kilometers (longitudinal), then the length of forest contour for the area under consideration (2,800 square kilometers) will amount to 15,000 kilometers.

Thus the disruption of the relief by forest plantings which is observed in nature is one-third to one-fourth less than that which is designated by plan. However it seems hardly possible that the increase in quantity of precipitation would be directly proportional to the increase in contours, since the wind will partially blow through the forest belts, and the level of condensation will be higher in southern than in northern regions. But if on this account the influence of additional roughness drops even by three or four times, we still have a right to expect an increase of precipitation by 10 to 15 percent.

We have completely ignored here the analysis of additional possibilities for changing precipitation by increase of evaporation through regulation of river flow, creation of irrigated cultivation and development of afforestation. This problem, which has a history many years old, has been elucidated in other works and goes beyond the limits of this article.

The conformities to law which have been established in the present work allow us to approach anew the clarification of the possibilities for change of climate in directions necessary for the national economy. It is essential to note that as a result

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of the mutual interconnections of hydrometeorological factors, a change of one of the basic parameters automatically produces a change in the others. This applies primarily to the temperature and humidity of the air. In fact, as a consequence of an increase in precipitation, cloudiness and evaporation, the air temperature in the warm time of year should fall, and the humidity of the air should rise.

The calculations of influence of field-protective forest belts upon precipitation conducted here should be looked upon as rough estimates of only qualitative significance; the trend of the process, however, is beyond doubt.

It is essential that both theoretical and experimental research on this problem be continued in order that a quantitative estimate may be made of the possibility of changing climatic, hydrological and soil conditions in the direction necessary for the national economy, and also to complete the designing, and in the very near future the exploitation, of field-protective forest belts.

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THE QUESTION OF INFLUENCE OF THE ALTITUDE OF A LOCALITY ON TEMPERATURE AND PRECIPITATION

I. Ye. Buchinskiy

I

The vertical distribution of temperature in mountain regions is considerably more complex than in the free atmosphere, since substantial influence is exerted upon it, not only by the absolute elevation of the locality above sea level, but also by the form of the topography and the general climatic conditions of the given territory.

A. I. Voyeykov [2] considers it risky to reduce the temperature to sea level in those regions where the vertical temperature gradient has not been established by direct observations.

The value of the vertical temperature gradient has been repeatedly determined, but not using materials of observation from the Ukraine. The diversity of the results of calculations of the vertical temperature gradients in other rayons [1, 8, 3, 7, 4] prompted us to derive the value of the vertical temperature gradients for the Ukraine.

After careful analysis of observations made by several dozen stations we dwelt upon the data of 17 pairs of stations (Table 1). These pairs of stations were selected with observation of the following conditions:

(a) the distance between them should not exceed 50 kilometers;

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(b) they should be located at different elevations above sea level and

(c) should be characterized by a relative similarity in topography.

In our work materials of observation made by these stations from 1881 to 1935 were used.

TABLE 1

Number	Station Pair	Elevation Above Sea Level in Meters	Distance between Pair of Stations in Kilometers
[1]	[2]	[3]	[4]
1	1	620	35
2		368	
3	2	579	40
4		440	
5	3	579	46
6		335	
7	4	772	25
8		440	
9	5	719	40
10		335	
11	6	719	20
12		400	
13	7	719	30
14		375	

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[1]	[2]	[3]	[4]
		820	45
15	8	343	
16		820	25
17	9	430	
18		820	48
19	10	596	
20		800	24
21	11	430	
22		250	25
23	12	95	
24		208	36
25	13	100	
26		176	15
27	14	91	
28		180	16
29	15	73	
30		334	40
31	16	120	
32			68
33	17	252	
34			

Cited in Table 2 are the values of the vertical temperature gradients for a series of stations located in more or less similar types of topography.

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TABLE 2

Month	Station Pair								Average
	4	5	6	7	12	14	16	17	
January	0.66	0.81	0.82	0.76	0.77	9.59	0.51	0.47	0.67
February	0.57	0.57	0.75	0.52	0.65	0.35	0.51	0.58	0.56
March	0.57	0.52	0.60	0.47	0.58	0.71	0.56	0.42	0.55
April	0.48	0.70	0.63	0.58	0.52	0.24	0.51	0.53	0.52
May	0.63	0.44	0.38	0.33	0.71	0.24	0.30	0.32	0.42
June	0.78	0.60	0.60	0.61	0.52	0.47	0.56	0.63	0.60
July	0.81	0.65	0.78	0.61	0.65	0.47	0.30	0.47	0.59
August	0.45	0.44	0.31	0.26	0.47	0.47	0.00	0.32	0.31
September	0.42	0.57	0.38	0.44	0.06	0.35	0.00	0.11	0.29
October	0.33	0.44	0.41	0.32	0.13	0.35	0.30	0.21	0.31
November	0.51	0.65	0.66	0.58	0.45	0.59	0.51	0.53	0.56
December	0.36	0.70	0.82	0.58	0.65	0.35	0.61	0.69	0.60
Year	0.55	0.59	0.59	0.50	0.50	0.43	0.38	0.44	0.50
Range	0.48	0.38	0.51	0.50	0.71	0.47	0.61	0.58	0.38

As is apparent from the data of this table, we obtained a value of the vertical temperature gradient which varies little with the season of year and amounts on the average to 0.5 degree. Nevertheless one can see that the vertical temperature gradient, even with more or less uniform types of relief, does vary both in space and in time: its average value for a year for individual pairs of stations fluctuates from 0.38 to 0.59 degree, and the range, from 0.38 to 0.71 degree.

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With comparison of stations located in heterodynamic topographical conditions the results obtained are somewhat different. Cited in Table 3 are the values of the vertical temperature gradients for a series of stations where the higher of each pair is located in conditions of relatively convex relief and the lower in concave. In Table 4, conversely, the upper station is located in conditions of a concave type of relief and the lower in convex.

TABLE 3

Month	Station Pair							Average
	1	8	9	11	10	13	15	
January	0.12	0.27	0.44	0.62	0.36	0.37	0.27	0.35
February	0.28	0.23	0.44	0.66	0.22	0.37	0.18	0.34
March	0.36	0.33	0.51	0.59	0.63	0.46	0.45	0.48
April	0.60	0.69	0.90	1.00	1.03	0.74	0.45	0.77
May	0.56	0.79	0.95	1.03	0.98	0.46	0.54	0.76
June	0.56	0.73	0.82	0.92	0.85	0.93	0.63	0.78
July	0.48	0.79	1.00	1.00	1.12	0.65	0.90	0.85
August	0.60	0.69	0.82	1.03	0.98	0.56	0.72	0.77
September	0.56	0.69	0.92	1.03	0.89	0.37	0.45	0.71
October	0.36	0.52	0.74	0.84	0.94	0.37	0.63	0.63
November	0.44	0.44	0.69	0.73	0.80	0.37	0.54	0.57
December	0.36	0.31	0.62	0.62	0.67	0.19	0.45	0.46
Year	0.44	0.54	0.74	0.91	0.79	0.49	0.52	0.63
Range	0.48	0.56	0.56	0.44	0.90	0.74	0.72	0.51

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TABLE 4

Month	Station Pair		Average	Month	Station Pair		Average
	3	2			3	2	
January	1.10	1.22	1.16	August	0.86	0.72	0.79
February	1.07	1.51	1.29	September	0.82	0.94	0.88
March	0.82	1.22	1.02	October	0.62	0.86	0.74
April	0.86	0.65	0.76	November	0.70	0.72	0.71
May	0.74	0.79	0.76	December	0.70	0.72	0.71
June	0.70	1.08	0.89	Year	0.81	0.99	0.90
July	0.78	1.37	1.08	Range	0.48	0.86	0.58

It is apparent from Table 3 that the gradient is higher in summer than in winter, the summer gradient at individual stations even exceeding 1.0 degree. Its average yearly value amounts to 0.63 degree and fluctuates from 0.44 to 0.91 degree. The range lies within the limits 0.44 to 0.90 degree.

With comparison of stations where the upper is located in concave relief conditions and the lower in convex (Table 4), we obtain gradients of rather considerable absolute value which are higher in winter than in summer. In the winter months the gradient reaches 1.51 degrees. Its average value for the year amounts to 0.90 degree. The range lies within the limits 0.48 to 0.86 degree. Such a type of gradient, but with more strongly expressed contrasts, was obtained by P. I. Koloskov for Kazakhstan [4], and A. I. Voyeykov [2] spoke of its possibility in his time.

Thus the data of tables 2-4 testify to the necessity of

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strict calculation of the type of relief in the derivation of values of the vertical temperature gradient.

It should be pointed out that the values of the vertical temperature gradient we have obtained for the Ukraine territory differ from the data obtained by I. Z. Figurovskiy for the Kavkhaz, A. V. Voznesenskiy for Siberia and P. I. Koloskov for Kazakhstan. This confirms A. I. Voyeykov's correctness in warning more than fifty years ago against the application of coefficients without direct determination of the vertical temperature gradient for each individual climatic region.

II

The research conducted by P. I. Koloskov [5,6] has disclosed that in the mountains of the Caucasus, Transcaucasia and Far East the quantity of falling precipitation increases approximately 20 percent (in relation to the quantity of precipitation at sea level) with every 100 meters' increase in altitude. For the Crimea he fixed this increase at 14 to 15 percent; for Silesia Shubert found it to be equal to 12 percent.

For the mountainous parts of Kazakhstan (Altay, Dzhungarskiy Ala-Tau and the mountains of South Kazakhstan) this increase proved to be equal to 100 percent. "This is a colossal magnitude, unknown to us in any other locality", writes P. I. Koloskov [4]. In his opinion "the revealed fact indicates, in the first place, that the higher layers of the atmosphere contain a sufficiently large quantity of water vapor and, in the second place, that outside mountain regions the necessary conditions for its condensation are absent".

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We have made an attempt to establish the relationship between the falling precipitation and the altitude of localities above sea level in the Ukraine. As raw material we used the observation results of 114 meteorological stations situatted in the most diverse topographical conditions and counting not less than 25 years of observation.

Having constructed a graph of the correlation of precipitation with altitude, where the quantity of precipitation was plotted along the abscissa and the altitude along the ordinate, we obtained a straight-line dependence of precipitation upon absolute altitude.

Using the curve on the graph a table of precipitations was drawn up for various altitudes, from 0 to 1,000 meters by fifties, the first line of the table giving the annual total precipitations and the second the percentages in relation to the quantity of precipitation at sea level (Table 5).

TABLE 5

	Altitude above Sea Level in Meters									
	0	50	100	150	200	250	300	350	400	450
millimeters	355	400	445	490	540	590	635	680	730	775
percent	100		125		152		179		206	

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Altitude above Sea Level in Meters											
	500	550	600	650	700	750	800	850	900	950	1000
millimeters	825	870	915	965	1010	1060	1105	1150	1200	1245	1295
percent	232		258		284		311		338		365

The data of this table show that the altitude of the place increases the total annual precipitation by 25-27 percent for every 100 meters, or on the average by 26 percent.

In order to check to what extent the obtained results apply to all the territories of the Ukraine, the total annual precipitations of all the stations we had selected were reduced to sea level, for which purpose Koloskov's formula [4] was used:

$$H_o = \frac{H_h}{1 + k},$$

where H_o is the total precipitation at sea level, H_h is the total precipitation at altitude h, and k is a coefficient determined by observations.

As has already been said, the change in precipitation for every 100 meters increase in altitude is equal on the average to 26 percent; consequently k (the fraction of unity per one meter) is here equal to 0.0026. Thus the following specific formula was applied:

$$H_o = \frac{H_h}{1 + 0.0026\ h}$$

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We plotted the total annual precipitations reduced according to this formula on a chart and discovered that the distribution of precipitation at sea level is rather diversified. The cause of this lies in the fact that, together with absolute altitude, such factors as the position of the station in relation to the winds which bring the precipitation and the type of relief also play a substantial part in the distribution of precipitation. Nevertheless it is apparent from the chart that the quantity of precipitation increases in proportion to the departure from the south toward the north. In the western oblasts of the Republic the latitudinal distribution of precipitation is disrupted by the Carpathian mountains.

Thus for the first time in the Ukraine territory work has been conducted on both determination of the value of the vertical temperature gradient and determination of the index of increase of quantity of precipitation with altitude.

REFERENCES

1. Vil'd, G. I., Air Temperature in the Russian Empire. SPb., 1882.
2. Voyeykov, A. I., Climates of the Globe, and in Particular of Russia. SPb., 1884.
3. Voznesenskiy, A. V. and Shostakovich, V. B., Basic Data for Study of the Climate of Eastern Siberia. Irkutsk, 1913.
4. Koloskov, P. I., Division of Kazakhstan into Agroclimatic Regions. Publications of the Academy of Sciences USSR, 1947.

Declassified in Part - Sanitized Copy Approved for Release 2012/04/23 : CIA-RDP82-00039R000200170026-4

Declassified in Part - Sanitized Copy Approved for Release 2012/04/23 : CIA-RDP82-00039R000200170026-4

5. Koloskov, P. I., Climatic Foundations of Agriculture in Amur Guberniya. Blagoveshchensk, 1925.

6. Koloskov, P. I., The Calculation and Mapping of Atmospheric Precipitations for Compilation of the Water Balance and Other Practical Purposes. Problems in Physical Hydrography, number 7, 1939.

7. Rubinshteyn, Ye. S., Average Monthly Temperatures in the European part of the USSR. USSR Climate, part 1, The Temperature of the Air, number 1, Leningrad, 1926.

8. Figurovskiy, I. V., Research Experience in Climates of the Caucasus volume 1, SPb., 1912.

Declassified in Part - Sanitized Copy Approved for Release 2012/04/23 : CIA-RDP82-00039R000200170026-4

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THE QUESTION OF THE SPATIAL STRUCTURE OF OCCLUSION FRONTS

Zh. D. Zubyan

Research on occlusion fronts, some of the results of which are given below, has been based for the most part on analysis of the temperature fields at various isobaric surfaces (isobaric temperature fields). This method has fully justified itself and is for practical purposes the most accessible. Let us recall that the isobaric temperature is proportional to the potential temperature [2].

1. It is known that an occlusion front corresponds to a warm crest on the OT [Relative Topography] 500/1000 millibar chart. This conforms with the spatial structure of an occlusion front and testifies to the presence of a warm sector aloft. However, not every warm crest on the OT 500/1000 millibar chart corresponds to an occlusion front, first of all because this crest exists when a cyclone is not yet occluded and has a warm sector at the earth's surface. On the other hand, a warm crest is also often observed on this chart in advance of a cold front and behind a warm front. These circumstances hamper the analysis of fronts with the help of OT 500/1000 millibar charts and thus lower their practical value.

A way out of this situation proves to be analysis with the help of isotherm charts drawn up for various isobaric surfaces (in practice, for the 900, 700 and 500 millibar surfaces).

Our research has shown that there is a warm crest corresponding to an occlusion front not only on the OT 500/1000 millibar chart, but also on the isotherm charts of various isobaric surfaces, beginning with the 900 millibar isobaric surface. And the most essential thing here has proven to be the fact that this warm crest changes its spa-

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tial position from one isotherm chart to another with the presence of warm or cold front occlusions. In the case of a warm front occlusion the crest (its axis, which usually coincides with the line of zero advection) moves noticeably forward from the lower isotherm charts to the higher, and in the case of a cold front occlusion moves backward. This is represented diagrammatically in Figure 1, where the line of a front on the synoptic chart of the earth's surface and the position of the warm crest on the lower (I) and upper (II) isotherm charts are given. The diagrams constructed obviously give only the most general representation of the phenomenon described above and must by no means be accepted as the only ones possible. In each individual case the warm crests on the isotherm charts may be situated differently relative to the line of the front at the earth's surface, the essential thing being that in the case of the presence of a warm or cold front occlusion the crests intermittently change their spatial position at some layer.

Let us note that the displacement of the warm crest is as a rule greater in the case of a warm front occlusion than in the case of a cold one. On the other hand the displacement of the warm crest (its axis) with altitude is accomplished only between two isotherm charts of the same time, remaining immobile on the underlying and overlying charts.

The two types of warm front occlusion are given in the diagram: the first type (Figure 1a), where the warm front is of considerable vertical extent with a normal slope, corresponds to the generally accepted scheme; the second type (Figure 1b), where the warm front has already gone into inversion at low altitude, corresponds to the scheme given by Kh.P. Pogosyan and N.L. Taborovskiy [1]. Let

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us remark that the double dotted line in the upper righthand part of figure 1b does not represent a front, but the zone of increased horizontal temperature gradient which is observed in the forward part of an high-altitude warm crest.

On the score of temperature distribution the first type differs from the second in that the warm crest corresponding to it makes a jump forward from one level to another (from the isotherm chart of the 900 millibar isobaric surface to the isotherm chart of the 700 millibar isobaric surface this jump amounts on the average to 300-400 kilometers) which is considerably less, and is noticeably less extended in area, than in the case of the second type, where this jump is often on the order of 1,000 kilometers.

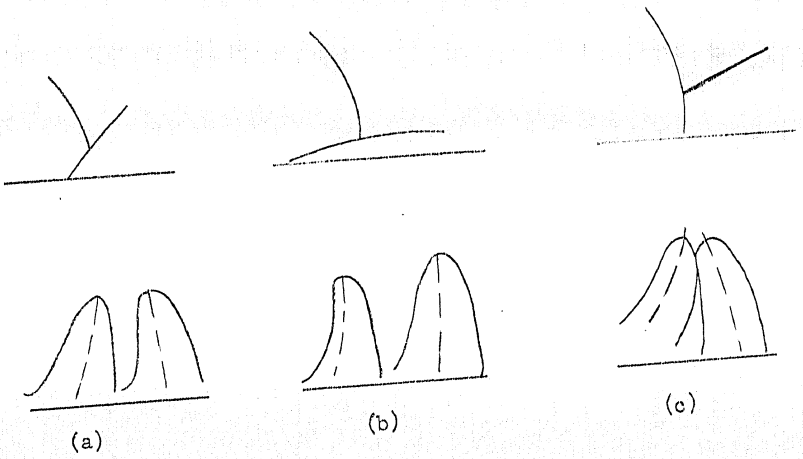

Figure 1. Diagrams of occlusion fronts. Position of the warm crest at the lower (1) and upper (II) occlusion line

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Let us examine an occlusion front which is a good illustration of the above (Figure 2). As it is not difficult to see in the diagram, there corresponds to this occlusion front on the isotherm charts (Figure 2b, c, d) a warm crest which accomplishes a jump forward (by approximately 375 kilometers) between the isotherm charts of the 900 and 700 millibar isobaric surfaces. (On this isotherm chart [2c] as in all the following isotherm charts of the 700 millibar isobaric surface a double dotted line indicates the position of the warm crest axis on the corresponding isotherm chart of the 900 millibar surface.) The warm front of the given occlusion is well expressed, judging from the isothermic field, at all altitudes and has a slope of about 1:180. Let us remark that from the 700 millibar isotherm chart to the 500 millibar isotherm chart the indicated heat crest does not change essentially in spatial position.

The observed displacement with altitude of the warm crest corresponding to an occlusion front confirms that the accepted spatial diagrams of occlusion fronts (having in mind simple diagrams) answers to reality.

Thus warm crests on lower isotherm charts, on which their displacement with altitude is not yet noticeable, testify to the presence of lower fronts: warm (in the case of a warm occlusion) and cold (in the case of a cold occlusion); the displacement of the crest with altitude proceeds from the isotherm chart of the isobaric surface which is situated below the occlusion line (the line of intersection of the upper warm and cold fronts in an occlusion system) to the isotherm chart of the isobaric surface located above this line. On the latter chart the warm crest testifies to the presence of a warm sector aloft. On the following isotherm

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charts, naturally, the warm crest expressing that same warm sector will not essentially change its spatial position, but can only increase in area, as is also observed in actuality.

[See text, page 28 for maps comprising Figure 2]

(b) (a)

(c) (d)

Figure 2. Morning of 29 November 1943.

(a) - synoptic chart at the earth's surface; (b) isotherms at AT [Absolute Topography], 900 millibars; (c) isotherms at AT 700 millibars; (d) isotherms at AT 500 millibars.

2. Two types of warm front occlusion have been given above, but, as we know, in the opinion of Kh.P. Pogosyan and N.L. Taborovskiy [1] the most acceptable diagram of the spatial structure of a warm front occlusion which is conformable with the structure of the thermobaric field of the troposphere and with the process of occlusion of a cyclone is the diagram which registers that the warm front in the occlusion system already goes into inversion at a low altitude (Figure 1b). Our research shows that in the predominant majority of cases in the European territory of the Union the structure of warm front occlusions in the wintertime actually does correspond to that given in the indicated author's diagram, but warm front occlusions with a warm front of great vertical extent (Figure 1a) are not unknown. This does not contradict the conclusions concerning

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the occlusion of cyclones to which Kh. P. Pogosyan and N. L. Taborovskiy come, but only confirms the hypothesis that the joining of cold and warm fronts occurs only in the lowest part of the troposphere.

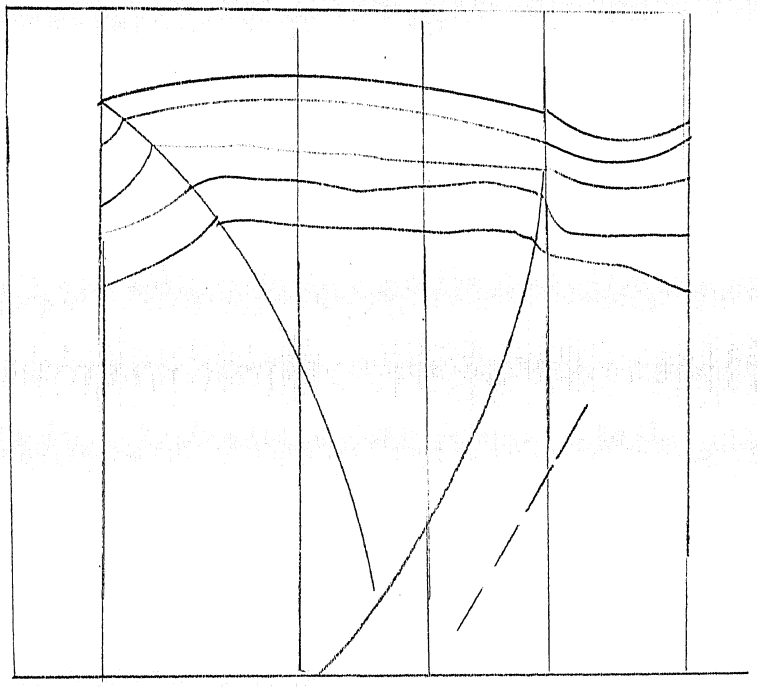

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Figure 3. Vertical section of morning of 29 November 1943.

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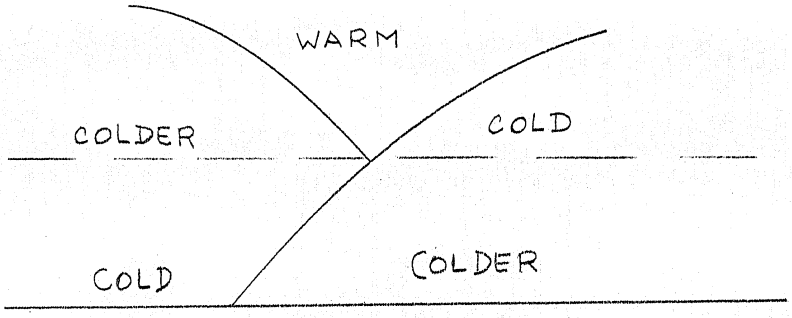
An example of a warm occlusion front of great vertical extent has already been given above. Its vertical section (Figure 3) shows that the warm front of the occlusion front extends to an altitude of 5-7 kilometers and, as was indicated above, has an inclination of about 1:180.

In connection with the question under consideration it is essential to direct attention to the following.

In Berzheron's diagram of an occlusion front [4] it is assumed that the relatively warm air at the earth's surface, coming in behind the warm front, remains warmer than the air in advance of it at all altitudes. In actuality this is not so. In the majority of cases, owing to the great vertical temperature gradients which exist, the warm air at the earth's surface becomes noticeably colder at a definite altitude than the air in advance of the front. Then the distribution of warm and cold air masses in the occlusion system presents a picture such as is schematically given in Figure 4. Warm occlusion fronts of the given structure are in full agreement with the structure of the thermobaric field.

FIGURE 4.



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3. At the present time it is customary to consider that the joining of warm and cold fronts, having begun with at moment of formation of the occlusion front at the earth's surface, may extend to great altitudes of the troposphere. This means that the occlusion line and the upper fronts (the warm front in a cold front occlusion system and the cold front in a warm front occlusion system) may go up to these altitudes.

Research data do not bear out this assumption.

It follows from what has been set forth that by plotting the isotherm charts one may determine at what altitude (or rather, between what altitudes) the occlusion line of a given front is located. For this purpose it is sufficient to know between what isotherm charts the abrupt displacement of the warm crest (its axis) corresponding to the given occlusion front is accomplished.

Analysis of numerous occlusion fronts, specially selected for this study, but also obtained in the process of practical work, shows that in all cases the displacement of the warm crest either does not appear with altitude or appears only between the 900 millibar and 700 millibar isotherm charts; this displacement is not observed on the isotherm charts of higher levels. On this basis we have the right to confirm that the joining of warm and cold fronts occurs as a rule only in the lowest layer of the troposphere, and the occlusion line and upper fronts, however "old" the occlusion may be, cannot rise very high.

One remark should be made here. It was stated above that by observing the position of the warm crest corresponding to a given front on the isotherm charts one may determine whether there is an

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occlusion front or not and at what approximate altitude the occlusion line occurs.

Nevertheless, in cases where the formation of the occlusion front has occurred not long before or temperature contrasts along its lower front are almost absent, it is often observed in reality that the position of the warm crest (its axis), beginning with the isotherm chart of the 900 millibar isobaric surface, scarcely changes at all with altitude and approximately coincides with the position of the crest (its axis) on the Relative Topography 500/1000 millibar chart. In addition the axis of the warm crest on various isotherm charts and on the Relative Topography 500/1000 millibar chart at the same time almost coincide with the front line on the synoptic chart at the earth's surface. Thus a warm crest on the Relative Topography 500/1000 millibar chart may represent an occlusion which has been recently formed or which does not have marked temperature contrasts along the lower fronts. The essential thing in this case is that the axis of the warm crest should coincide with the line of the front on the synoptic chart at the earth's surface. Here it should be noted that if the above-indicated conditions are fulfilled but the axis of the warm crest is not superposed upon the line of the front on the synoptic chart at the earth's surface, then the given front is cold if the warm crest is located in advance of the front line and warm if the warm crest is located behind the front line.

4. From the point of view of frontal structure one may distinguish two types of developing cyclones.

To the first type belong cyclones with a relatively simple structure: warm and cold primary fronts and secondary fronts. The

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masses of air occupying the warm sector of such cyclones are homogeneous enough and in it only terrestrial-surface fronts arising as a consequence of convergence of wind in the friction layer are possible.

To the second type belong cyclones whose systems include, in addition to the fronts indicated above, occlusion fronts in the warm sectors.

Cyclones of the first type are those which are newly arising or those regenerating cyclones whose regeneration was begun after they reached a stage of great thermal homogeneity and no fronts remain in their systems except those at the earth's surface. Cyclones of the second type are those regenerating cyclones whose regeneration was begun when they had not yet reached the stage of great thermal symmetry, and occlusion fronts still survive in their systems.

The present study has shown that these two types of cyclone differ sharply in their spatial thermic structures; this may be discovered through analysis of isotherm charts of various levels.

In cyclones of the first type the picture of distribution of temperature does not essentially change with altitude -- the warm crest which appears on the lower isotherm chart (900 millibars) and corresponds to the warm sector scarcely changes its position with altitude and only increases in area, in accordance with the slope of the fronts which form the warm sector.

In cyclones of the second type the warm crest which appears on the lower isotherm chart changes its position in an essential manner with altitude, accomplishing a noticeable displacement forward and veering off to the side from the cyclone. As a consequence

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a zone of increased temperature contrasts is observed above the cyclone and its warm sector at the earth's surface (at an altitude of 3-5 kilometers). A cyclone which was observed over Scandinavia on the morning of 19 April 1943 (Figure 5) will serve as an example of the first type; a cyclone observed over the southern Gulf of Bothnia on 7 February 1943 (Figure 6) will serve as an example of the second type.

The changes in temperature distribution with altitude which are discovered in the region of a cyclone are explained by the presence in its warm sector of the warm front of an occlusion behind the upper cold front of which, in the upper reaches, the cold air is spread far toward the east.

The research results set forth above may be used in analysis for the detection of fronts.

One may judge as to the presence of an occlusion front in the warm sector by the change in the picture of horizontal temperature distribution with altitude. If the warm crest (its axis, which coincides with the line of zero advection) corresponding to the warm sector does not essentially change its position with altitude, this indicates the absence of an occlusion front in the warm sector. In the opposite case we have an indication of the presence of an occlusion front in the warm sector.

In connection with what has just been said it should be noted that the analysis of numerous cyclones with occlusion fronts in their warm sectors shows that in the wintertime, in all the sufficiently diverse cases we selected the warm crests corresponding to the warm sectors moved forward with altitude. On this basis we are

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inclined to conclude that in the physicogeographical conditions of Europe in the wintertime occlusion fronts in the warm sectors of cyclones are as a rule of the warm-front type.

5. At the present time there is a dispute going on among synopticians as to the possibility of existence of so-called "bent" ends of an occlusion.

This dispute is a matter of principle. It is altogether obvious that for the forecasting of weather it cannot be an indifferent matter whether a given front appears in a cyclone system as an occlusion or as a secondary front, since these fronts, as noted earlier, differ sharply in their spatial structure. On the other hand, as we know [3], the bent ends of an occlusion front are connected with the processes of regeneration of a cyclone. Finally, acknowledgement of the real nature of the "bent" ends of an occlusion makes possible the construction of diagrams of "double" and "triple" occlusions.

In the present work we have set ourselves the purpose of verifying one or the other point of view on the basis of available aerological material. Investigating in various seasons numerous fronts associated with various synoptic situations given on the Central Forecasting Institute's ground charts as "bent" occlusion fronts (The research with the aid of isotherm charts of various isobaric surfaces was conducted on the basis of the position set forth above), we came to the following conclusion: all of them, with the possible exception of one case of which something will be said below, proved to be in actuality secondary and ordinary cold fronts, the latter in many cases having sufficiently great temperature

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[See text, page 31 for Figure 5]

Figure 5. Morning of 19 April 1943.

a - synoptic chart at earth's surface; b - isotherms at AT 900 millibars; c - isotherms at AT 500 millibars.

[See text, page 32 for Figure 6]

Figure 6. Morning of 7 February 1943.

(b) (a)

(c) (d)

a - synoptic chart at earth's surface; b - isotherms at AT 900 millibars; c - isotherms at AT 700 millibars; d - isotherms at AT 500 millibars.

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contrast to be designated as dynamically signified. Occluded cyclones continued to deepen or began to regenerate just when such fronts were present in their systems as had appeared as a consequence of the preservation or new formation of noticeable temperature contrasts in their regions.

The exceptional case indicated above, when a front in the rear of a cyclone might have been designated as an occlusion, belongs to the process of formation of a particular cyclone at the point of occlusion. Then the occlusion front joined the old cyclone with the new, preserving its structure as a complex system with upper fronts, but on the charts of isotherms and relative topography there corresponded to it a warm crest which was traced to great altitudes. Let us remark that in this case the occlusion front was relatively immobile.

The erroneous notion obtained concerning the possibility of existence of "bent", and not one but several, occlusion fronts is the consequence of a completely one-sided interpretation of the processes, founded on the examination of kinematic conditions and front lines exclusively on the synoptic charts of the earth's surface. It is as if one forgot that occlusion fronts are complex spatial systems, with upper fronts and upper warm sectors, and, on the other hand, that the baric field and the system of winds given on the ground synoptic chart change considerably with altitudes.

Kh. P. Pogosyan and N.L. Taborovskiy are right in considering that "occlusion fronts, in accordance with the structure of the high-altitude currents in a cyclone, cannot, once having bent, pass to the rear part of the cyclone through its center" [1].

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It must be emphasized that we do not have in mind here the front line at the earth's surface, but the whole occlusion system with its upper fronts. In general, if one takes into account the essential conditions relating to the spatial structure of cyclones, the slope of their vertical axes and the increase of wind with altitude, it is scarcely possible to construct a spatial model of a cyclone which admits a bend of the occlusion front, as an integral system, to its rear part. In these attempts we shall always obtain a "rupture" of the cyclone expressed in the fact that the line of the front at the earth's surface and the upper fronts will move in different directions -- the first will rush to the inside of the cyclone, bending into its rear part, and the second will rush to escape from the cyclone system, moving to the heights in the direction of the wind.

The fact, already generally known and confirmed in daily work, that, according to the degree of occlusion of a cyclone, the warm crest corresponding to its warm sector gradually veers to the side, is found to be in full agreement with the latter circumstance.

The research results set forth above relative to the reality of the "bent" ends of an occlusion, on the one hand, and the circumstance that the joining of fronts is limited to only the lowest layer of the troposphere and therefore the occlusion line cannot rise very high, on the other, give us the right to assert that the existing diagrams of "double" and "triple" occlusions do not conform to reality. In any case, our attempts to find any isolated example at all testifying to the reality of such fronts gave no positive results.

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The research results set forth above show, in the first place, that the existing representations of the spatial structure of fronts may be broadened and made more precise and, in the second place, that isotherm charts drawn up for various isobaric surfaces may render substantial help in the practical work of front analysis.

REFERENCES

1. Pogosyan, Kh.P. and Taborovskiy, N.L., Advectional-Dynamic Bases of Frontological Analysis. Trudy TsIP, number 7, (34), 1948.

2. Zverev, A.S., Thermodynamic Analysis of Baric Topography Charts and Application of the Advectional-Dynamic Method to Precipitation Forecasting. Trudy TsIP, number 14, 1946.

3. Khromov, S.P., Fundamentals of Synoptic Meteorology, Gidrometeoizdat, 1948.

4. Berzheron, T., Coordinated Three-Dimensional Synoptic Analysis, part 2, 1934.

Declassified in Part - Sanitized Copy Approved for Release 2012/04/23 : CIA-RDP82-00039R000200170026-4

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VARIATION OF SOIL MOISTURE RESERVES IN THE WINTER PERIOD

L. A. Razumova

Many years' observation of soil moisture shows that in practically all territories of the Union summer precipitation seldom compensates for the outlay of water in evaporation and transpiration, so that after the harvest the root-inhabited soil layer is insufficiently moistened. The process of regeneration of soil moisture reserves begins only in the period of steady temperature fall in autumn.

In spite of the great significance of this process, its nature has been little studied up to now. Some investigators consider that the moisture reserves in the root-inhabited soil layer are restored by precipitation and by thaw waters filtering into the soil. Other investigators allot the big role in this process to the intrasoil movement of water from lower-lying levels to higher.

According to A.F. Lebedev's theory, water moves from the bottom in the soil in winter in the vapor state, and this movement is a consequence of the seasonal distribution of water-vapor pressure in the soil and bottom which is stipulated by soil temperature gradients.

V.R. Vil'yams explains the accumulation of large quantities of water in winter under conditions of the turf soil-forming process to a considerable extent in terms of vaporiform transfer of moisture in the soil. Side by side with this he acknowledges a transfer of water to the frozen soil layers in the liquid state also, explaining it by crystallization phenomena.

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M.I. Sumgin allots an especially large role to crystallization phenomena. In his words, in freezing, and later in frozen ground the quantity of moisture at a given point is a function of the freezing processes. In M.I. Sumgin's opinion, moisture in the soil may migrate in vapor and liquid form. Describing one of the experiments studying water migration, he asserted that in this experiment there occurred a literally obvious transfer of water in liquid form at the time of freezing of the ground, the water having moved upward in spite of the law of gravitation.

One of the causes of such contradictions in interpretation of this question is the absence of widely conducted observations in natural conditions.

In the system of the Hydrometeorological Service USSR material is now collected which permits exposure of the basic features of the process of regeneration of soil moisture reserves in the territories of the European part of the USSR.

Analysis of the mass soil-moisture observations of agro- and hydrometeorological stations shows that in autumn, by the time the average daily air temperature has fallen below 5 degrees, which practically coincides with the cessation of the growing period for agricultural crops, the stores of productive moisture in soils of the European territory USSR vary within wide limits, decreasing from northwest to southeast. In the northwestern rayons the tillable soil layer contains about 60 millimeters of productive moisture, whereas in the southeastern rayons it contains only 20-25 millimeters in all. In a meter layer of soil the moisture stores amount to 200-220 and 60-90 millimeters respectively; that is, they similarly decrease to approximately one-third from northwest to southeast.

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If in the same year the southeastern rayons are maximally wetted and the northwestern minimally, the stores of moisture in the soil still remain greater in the northwest than in the southeast.

In the period from the time the temperature passes 5 degrees to the time when it passes 0 degrees the moisture stores are increased owing to precipitation. However, the proportion of moisture saturation of separate layers of the soil in the various zones of the European territory USSR remains as before. Only the moisture content of the tillable layer levels off somewhat. A meter layer of soil in the northwestern oblasts contains 200-250 millimeters of productive moisture by the beginning of winter. In the extreme southeast the stores of productive moisture as before do not reach 100 millimeters.

The above-indicated differences in absolute quantities of moisture also stipulate a difference in the properties of the water available in the soils of individual rayons by the beginning of the seasonal freeze.

It is known that moisture above and beyond the minimum field moisture capacity (The minimum field moisture capacity is accepted as the quantity of water retained by the soil when the mirror of free water lies so deep that the layer of capillary saturation lying above it does not reach the soil.) is bound extremely weakly because it is not bound at all to the soil particles and therefore has pronounced mobility. Moisture below the minimum field moisture capacity is strongly bound to the soil and has little mobility.

In the northwestern rayons, where the moisture stores in the

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prewinter period exceed the minimum field moisture capacity about one and one-half times, a large quantity of mobile moisture always exists in the soil by the beginning of winter.

In the central and adjoining northern oblasts the moisture is somewhat less than in the northwestern ra ons, but nevertheless exceeds the minimum field moisture capacity, and by the beginning of winter a smaller quantity of mobile moisture is observed in the whole soil thickness of these rayons.

Further to the southeast, in the northern half of the Ukraine, in the Central Black Earth Area and in Upper Povolzh', where the moisture stores do not exceed the minimum field moisture capacity by the beginning of winter, mobile moisture is observed only in the upper soil layers.

Beyond the Dnepropetrovsk-Penza-Kazan' line, where the soil moisture in the prewinter period is as a rule substantially below the minimum field moisture capacity and in Zabolzh' and Lower Povolzh' amounts to only 20-40 percent of this moisture capacity in all after the harvest, there is no mobile moisture at all.

The difference in mobility of moisture existing in the soils of separate geographical rayons by the beginning of winter stipulates the characteristic features of the dynamics of soil moisture in these rayons in the winter period.

In rayons with high moisture a considerable change in stores of soil moisture occurs in winter.

According to the averaged data of the Belogorsk Agrometeorological Station (Leningrad Oblast), whose area is characterized by

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intensive irrigation of the soil in autumn and by negligible water vapor tension gradients in the soil in winter, the moisture stores in the top 20-centimeter layer of soil increase by 55 millimeters during the winter. The soil moisture in the lower layers changes insignificantly and that in the direction of decrease.

In the meter layer the increment of moisture stores during the winter amounts on the whole to 43 millimeters, the maximum accumulation of moisture being recorded in February.

In individual years the increase in moisture stores on account of intrasoil movements reaches considerably higher limits. Thus in 1935-36 the moisture of the top half-meter layer of the soil rose in winter to 159 millimeters. In the tillable layer (0-20 centimeters) the moisture stores rose to 89 millimeters and amounted to 210 percent of the full moisture capacity of this layer in the thawed state. (The full moisture capacity (moisture storage capacity) is taken to be the quantity of water contained in the soil when the water mirror lies on one level with the surface, that is, when all the pores of the soil are occupied by water. The full moisture capacity corresponds to the total porosity of the soil.)

In individual years the absolute quantities of moisture in one or another layer change, but the proportion of moisture saturation of the levels and the nature of the movement of moisture in relation to the soil profile at the time of freezing remain the same.

Analysis of the materials of fifteen years' observation show that the water saturation of the soil in winter always (100 percent of cases) exceeds the capillary moisture capacity (The capillary moisture capacity is taken to be the quantity of water which the soil

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can retain in a suspended state above the free water surface on account of capillary force (owing to the difference in surface tension between the water in the capillary pores of the soil and on the surface of the water mirror), and in the 50 centimeter layer which freezes through often even goes beyond the limits of the full moisture capacity of the soil (more than 50 percent of cases). The process of excess accumulation of moisture in the winter period is expressed most sharply in the tillable layer (0-20 centimeters) which freezes through every year. In February and March the moisture stores in this layer exceed its full moisture capacity in 92 percent of the cases.

The moisture dynamics of the lower 50-100 centimeter layer, which does not freeze through, are entirely different. In this layer no winter increase of moisture is observed. Being in a state of continuous capillary moistening below, the 50-100 centimeter soil layer is like a transitional area through which the water moves from the over-moistened underlying layers to those above.

In certain years the moisture of the 50-100 centimeter layer drops below the limits of capillary moisture capacity (17 percent of cases in March). Analysis of the materials shows that these years correspond to significant shortages of precipitation in the summer-autumn period. This is obviously connected with a drop in the soil's capillary moistening front which brings about a break in the capillary supply of water from soil layers lying deeper than a meter.

Only one year out of the 15-year's observation period was characterized by a different soil moisture regime. In its conditions pronounced moisture accumulation was not observed in the soil in winter:

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even in the period of maximal increase, the moisture stores in the top half-meter layer only negligibly exceeded the maximum capillary moisture capacity.

The cause of such an infraction of the water regime typical for the Bezenchuk agrometeorological station region turned out to be a complete thawing out of the soil beneath a heavy snow cover in winter, which eliminated the possibility of migration of moisture from the lower-lying layers to the upper in this year. This once more confirms the direct connection between the increase of moisture stores and the freezing-through of the soil in rayons with high moisture, and accords with M.I. Sumgin's theory of the migration of moisture in the soil.

The dynamics of the winter water regime in a zone of unsaturated soils represented by the data of the Bezenchuk agrometeorological station is characterized by contrary features. This station, situated 70 kilometers from Kuybyshev in slightly argillaceous chernozem conditions, is characterized by a cold and persistent winter, a low-power snow cover and rather low soil temperatures. The water-vapor tension gradients in winter in the soils of Bezenchuk agrometeorological station are, according to averaged data, approximately one and one-half times the water-vapor tension gradients in the Belogorsk station's soils; the number of pores free from water before the beginning of the seasonal freeze-through of the soil is very great in Bezenchuk rayon; there is almost no mobile water.

According to the data of Bezenchuk agrometeorological station, the increase of moisture stores in winter owing to intrasoil movements is scarcely observed at all. On a winter-crop field and on

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ploughland after the harvest of summer crops the stores in the meter layer increase during the winter, in averaged magnitudes, by only 5-7 millimeters, and in the half-meter layer, by 3-5 millimeters. Marked increase of soil moisture stores is observed here only in the spring, at the time of the thaw. This proves to be the result of the filtration of thaw waters into the soil and has no connection with the process of moisture migration. The specified change in soil moisture in Bezenchuk rayon is of a regular nature, recurring from year to year.

Thus in rayons where according to A.F. Lebedev's theory one ought to expect great increases in moisture stores in the soil owing to its vaporiform movement in the winter, they are not observed (Bezenchuk), but in rayons where vaporiform movement of moisture in the soil is hampered, increase of soil moisture in the winter period is observed very markedly (Belogorks). Consequently, it is not this mechanism of migration which proves to be decisive in the process of regeneration of the moisture stores in the soil in winter.

In a zone of deep stand of ground waters and unstable winters, according to averaged data from the Sinel'nikov agrometeorological station, which is located in the steppe part of the Ukraine and is characterized by frequent melting of the snow cover and complete thawing of the soil in the middle of winter, during the freeze-through period in the upper 20-centimeter layer of the soil of a winter-crop field the moisture stores increase by 12 millimeters, and in the meter layer, by 14 millimeters. The maximum increase in stores is observed in the middle of March, when the soil is completely thawed out and the thaw waters penetrate to the deep

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layers. On fields after the harvest of agricultural crops the increase amounts to 17 millimeters in the 0-20 centimeter layer and 42 millimeters in the 0-100 centimeter layer of the soil.

In individual years the change in moisture stores during the autumn-winter period is considerably greater. Thus in 1934-35, in the span of a single thaw, accompanied by full melting of the snow cover and thawing of the soil, the moisture stores increased in midwinter on a winter-crop field by 35 millimeters and on plough-land from under summer wheat, by 88 millimeters.

Consequently, in a zone of deep-standing ground waters and unstable winters the basic factor determining the increase in soil moisture stores in wintertime is the filtration of thaw waters into the soil. But together with this, in the upper layers of the soil the migration of water may also have a definite significance. In this connection, the migration, as in other rayons, is found to be in a definite relationship to the degree of moistening of the soil, that is, to the presence of some quantity of mobile moisture in it.

We have conducted laboratory experiments in order to check the latter statement and to make more clearly apparent the conditions instrumental to intensified movement of moisture in the soil. For these purposes various degrees of moistening of the soil were created (with the help of driers) according to a scheme worked out beforehand in field conditions. From these variously moistened strips of the field soil specimens were taken without disturbing their structure, for freezing through in laboratory conditions. The freezing of the soil was conducted in the frozen-ground laboratory of the Frozen-Ground Authority Institute of the Academy of Sciences USSR. The experiment was organized in such a way that the inflow of

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cold was accomplished only from above, as occurs in the freezing through of soil in natural field conditions. The results of this experiment clearly showed that in dry soils, where there is no mobile water and movement of moisture can occur only in vapor form or in the form of thin films disconnected from one another (the kind of moistening corresponding to the coefficient of withering and 30 percent of the minimum field moisture capacity), migration of moisture is practically absent in the process of freezing through. In soils moistened up to the minimum field moisture capacity, where there is mobile moisture and its movement occurs in liquid form, a pronounced enrichment of the upper layers is observed, during which the drying of the bottom layer, which is last to freeze through, reaches 60-70 percent of its minimum field moisture capacity. Approximately the same picture is produced in capillary-saturated soil. In this case the quantity of moisture moving up from below increases, but the moisture of the bottom layer which is last to freeze through, if no inflow of water reaches it from below, remains at the same level as in the foregoing variant (20 percent of the absolutely dry weight or 65 percent of the minimum field moisture capacity).

With capillary inflow of water from without (the bottom of the soil specimen was in contact with a mirror of free water) all the layers of the soil in the process of freezing were markedly enriched with water. The quantity of moisture entering a soil sample 15 centimeters high amounted to 27 millimeters. After freezing, the moisture reached 103 percent of the full moisture capacity of the soil.

From the results of the laboratory experiments described

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above and of field research one may conclude that the movement of moisture in liquid form alone can guarantee practically significant replenishment of its stores in the soil in winter.

The mechanism of movement of moisture in liquid form can be represented in the following way.

With the onset of winter and the establishment of negative temperatures in the upper soil layers, formation of ice crystals begins. With freezing, the water molecules are drawn into the crystal lattice of the ice. As a consequence of this the thickness of the water film around soil particles located near an ice crystal decreases. A difference is created between the tension of the films around soil particles located in direct proximity to an ice crystal and the tension of the films around soil particles at a greater distance from an ice crystal, in soil which is not yet frozen through.

As a consequence of the tension difference, the moisture surrounding the more distant soil particles begins to advance toward the thinner water layers of the soil particles located in direct proximity to an ice crystal. In the process of growth of the crystal new water molecules are taken into it, as a result of which a difference is again created in the tensions of the films, inducing the moving in of new portions of water, and so on. In cases where mobile water exists in the unfrozen soil layers, the disrupted equilibrium at the boundary of freeze-through calls forth an inflow of mobile water from the unfrozen soil layers to the frozen layer, during which, in conditions where the stand of ground waters or a top accumulation of water is nearby, the drainage zone spreads down-

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ward, and the quantity of ice in the frozen layer is increased not only at the expense of the moisture stores in the underlying layer, but also at the expense of the supplementary inflow of moisture from the top accumulation or from the ground-water mirror.

The described scheme of movement of moisture in liquid form gives a good explanation of the presence of large quantities of indrawn water in winter in regions of surplus moistening and the absence of such indrawn quantities in regions of insufficient moistening.

On the basis of the materials which have been set forth one may distinguish the following types of moisture enrichment of the soil in the winter period:

1. Type of intensive moisture enrichment of the soil -- characterized by a zone of high moisture, geographically encountered in rayons with a close stand of ground waters and the presence of top accumulations; in the European territory of the USSR most clearly expressed in the northwestern rayons. Within the limits of this type the change in moisture stores proceeds on account of intrasoil movements of water in liquid form and amounts on the average to 40-50 millimeters during a winter, but in individual years exceeds 100 millimeters; accompanied by pronounced swelling and cementation of the soil in winter.

2. Type of insignificant or practically negligible change of moisture stores in winter (0-15 millimeters) -- conditioned by film or vaporiform intrasoil water movement, geographically encountered in rayons with deep stand of ground waters and stable winters, within the limits of European territory USSR most clearly expressed in the southeastern rayons.

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3. Transitional type -- depending upon the water saturation of the soil in autumn and on winter conditions, may be characterized both by intensive and weak moisture enrichment of the soil. Characterized by a zone of deep occurrence of ground waters and unstable winters, stipulating abundant moistening of the soil by thaw waters at the time of thaw, most clearly expressed in southwestern and northern rayons of the European territory of the Union; characterized by negligible migration of moisture from the layers of soil lying deeper than a meter and by rather pronounced intrasoil movement of water within the limits of the topmost layers.

REFERENCES

1. Vil'yams, V.R., General Farming on a Soil Science Basis. "New Agriculturalist" Publishing House, 1927.

2. Lebedev, A.F., Soil and Ground Waters. Izd. Academy of Sciences USSR, 1936.

3. Sumgin, M.I., Kachurin, S.P., Tolstikhin, N.I. and Tumel', V.F., General Frozen Ground Management. Izd. Academy of Sciences USSR, 1940.

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THE QUESTION OF INFLUENCE OF FORESTATION OF A RIVER BASIN ON THE HEIGHT OF THE SPRING FLOOD

I.V. Ivanov

The hydrological significance of forests has long been the subject of a great deal of research; Russian scientists have done especially much in the research on this question. However, in spite of this, there exists a whole series of questions related to the hydrological role of a forest to which we still cannot give general answers. To this group, first of all, belongs the question of the influence of the degree of woodedness of river basins on the formation of the spring flood and, in particular, on its maximum discharge. Some results of research on this question are given in the present article.

The fundamental principles of the influence of a forest on the formation of the spring flood were first expressed by the very great Russian scientist A.I. Voyeykov as early as the eighties of the last century. He considered that, as a consequence of the lowered intensity of thawing of snow in a forest and the increased infiltrational capacity of forest soils, a forest lowered the height of the spring flood and increased its duration. These principles, in spite of the fact that A.I. Voyeykov based them upon only fragmentary instrumental data, have retained their scientific value to this day.

In developing his ideas on the hydrological role of a forest, A.I. Voyeykov [1, 2] noted that as a consequence of the nonsynchronism of snow-melting in field and forest the greatest lowering of the maximum discharge of the spring flood is observed in conditions where "field alternates with forest" in a river basin. As an exam-

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ple of such a combination of field and forest, which evokes the greatest lowering of the height of the flood, he cited the basin of the Moscow River.

However, this correct hypothesis of A.I. Voyeykov has not found due response and development in subsequent hydrological research. The authors of works conducted in the course of the last 25 years -- D.I. Kocherich, D.L. Sokolovskiy, A.V. Ogiyevskiy, V.I. Rutkovskiy, V.I. Moklyak, L.T. Federov and others -- answer this question in terms indicating that the moderating influence of a forest on the maximum flood increases with increase of forestation and attains maximum value with solid forestation of a basin. In determining the quantitative characteristics of the influence of degree of woodedness some of these authors indeed take into account the distribution of forests in river basins (A.D. Dubakh, A.V. Ogiyevskiy,) and the composition of forest plantings (D.L. Sokolovskiy, A.V. Ogiyevskiy and others).

In conformity with this view, which is firmly established in the literature, a great number of empirical formulas have been proposed for estimation of a forest's influence on the maximum flood discharge. All these formulas proceed from the postulate that the greater the woodedness of basin, the greater must be the lowering of the maximum discharge of the spring flood and that, consequently, the greatest effect of a forest in lowering the flood height is observed with solid forestation of the catchment area.

Thus in not one of these formulas is A.I. Voyeykov's principle, that the moderating influence of a forest is most strongly manifested not with total, but only with partial forestation of a basin, taken into account.

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Many factors affect the magnitude of the maximum discharge of the spring flood. The collective influence of meteorological factors is ultimately manifested in the magnitude of the maximum water reserves in the snow, the intensity of the spring thaw, the depth of solid freezing and the degree of moistening of the soil. Substantial influence is exerted upon the flood by topography, soil bases, lakes and swamps. Forests occupy a special place in the formation of the maximum discharge of the flood.

The general effect of a forest on surface flow of thaw waters is expressed in decrease of maximum discharge and increase of the flood's duration. This regulating effect a forest has upon the flow is connected in the closest possible manner with the forest's action on the accumulation and melting of snow and on the flow of thaw waters.

A forest's effect on snow accumulation has been sufficiently fully elucidated by numerous research works, among which those of the Agricultural Academy imeni Timiryazev and the All-Union Science-Research Forest Economy Institute (VNIILKh) are especially outstanding.

It has been established by observation that a considerable part of the precipitation falling on a forest is caught by the treetops and evaporated from them, and thus the quantity of precipitation reaching the ground under the forest canopy is decreased.

This circumstance cannot, however, lead to a substantial decrease in the flood height, since the magnitude of the snow reserves has in general only secondary significance among the factors determining the formation of the maximum flood discharge.

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The snow-melting process, as we know, depends upon the nature of the spring, which is determined by the course of meteorological factors, the most decisive of these being air temperature and solar radiation. The difference in types of spring is determined primarily by the value of one of these factors which variously affect the snow-melting process.

In fields, the wind is of appreciable significance in acceleration of the snow-melting process, but in forests its role in this connection is insignificant, owing to its low velocity there. It has been established by special observation that the velocity of the wind in a forest during the snow-melting period is 6-10 times less than in a field. Naturally, with such low wind velocities, the heat exchange between the snow cover and the air is less intense in a forest than in a field.

In creating shade and screening, a forest strongly hinders the penetration of solar radiation and reduces its action on the snow cover.

Thus snow-melting in a forest proceeds primarily on account of inflow of heat from the air, with considerably weaker participation of solar radiation; therefore the course of snow-melting under the forest canopy is determined on the basis of the air temperature. But as a consequence of the weak circulation of air in the surface layer, the significance of air temperature as a factor in snow-melting is considerably lowered in a forest as compared to a field. This circumstance is also one of the basic causes of the retardation of snow-melting in a forest.

The retardation of snow-melting in a forest as compared to a

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field stipulates that the runoff of snow will occur later there. According to V.I. Rutkovskiy's data [3], snow-melting proceeds twice as slowly in pine and deciduous forests and 1.5-3 times as slowly in fir forests as in a field. In springs with rapid and continuous thawing of snow, according to his same data, the intensity of snow-melting amounts to 5 millimeters per 24 hours in fir plantings, 7 millimeters per 24 hours in pine, 9 millimeters per 24 hours in deciduous, and from 12-16 millimeters per 24 hours in clearings; in fields it is 1.5 times as high as in clearings.

One should keep in mind, however, that in lingering springs the second half of the thaw proceeds, as a fule, in the presence of high diurnal and nocturnal temperatures, which stipulate high intensity of snow-melting, not in the field, where by this time the snow is already almost dispersed, but just in the forest.

Conditions of surface runoff of thaw waters in a forest are considerably different from those in a field. The difference between runoff conditions in field and forest is manifested, in the final analysis, in the magnitude of the runoff losses, which, as has been established by numerous research works, is considerably greater in forest than in field.

But as we know, the increase of thaw discharge losses in a forest tells most strongly upon the decrease of the total flood volume in a wooded basin; the more thickly wooded the basin, the greater the total absorption of water in it. As for the maximum flood discharge, this factor tells on it to a considerably lesser degree, because the magnitude of the maximum discharge, as we know, is for the most part determined, other conditions being equal, by the intensity of snow-melting and its simultaneity over the whole basin under consideration.

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The development of the flood in time and its height depend first of all upon the intensity and synchronism of thaw and the shedding of the thaw waters into the rivers: the more intense this shedding, the higher the maximum flood discharge, its volume remaining equal. Therefore, in analysis of the influence of the degree of forestation on the maximum discharge, we should pay attention to this most important factor before any other.

As we know, a forest bed, the living cover and the soil in a forest, has a high water-absorptive power; therefore, during the thaw period, we observe surface runoff in a forest considerably later than the onset of water discharge from the snow. It begins only after the forest bed and soil have been saturated up to their maximum water capacity or when the intensity of water discharge exceeds the maximum water-absorptive power of the bed and soil. This naturally retards the shed of thaw water from forest territories as compared to field territories.

Snow-melting proceeds considerably more slowly in a forest than in a field. But both in springs with a rapid and continuous thaw and in lingering springs, the second half of the snow-melting period in a forest is characterized, as a rule, by higher air temperature and consequently by greater intensity.

Thus the conditions of runoff and snow-melting in forest lead to a later shedding of thaw waters than in field, in other words to a nonsimultaneous inflow of water from field and forest into a river. This circumstance is also decisive in the formation of the maximum flood discharge in a partially wooded basin.

Naturally the noncoincidence of shedding of "field" and "forest"

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waters, provided the entire basin is embraced by the thaw, must be manifested most sharply in the case of forestation of the basin by nearly one half.

Indeed, with precisely such forestation of a basin retardation of the fundamental mass of thaw waters flowing into the river from the forest has most significance, since in this case the "forest" waters, arriving later than the "field", play approximately the same part in formation of the flood as the field waters.

To the degree that the forestation of the basin is further increased, the role of the forest areas in formation of the flood will grow ever greater on account of the dwindling significance of the open areas, and as a consequence of this, the effect of the difference in times of shedding of thaw waters on the height of the flood will decrease correspondingly.

With solid forestation of the watershed the probability of nonsimultaneous shedding of thaw water, other conditions being equal, will become considerably less than with 50-percent forestation, being conditioned in this case only by the nature of the weather. In this proportion a forest basin is no different from a field. Due to the lower probability of delays in shedding of water, it should be expected that with identical conditions a somewhat greater maximum flood discharge will be formed in a fully forested watershed than in a basin with about 50 percent forestation, since the simultaneous inflow of thaw waters comes not from half, but from the whole area of the watershed.

Depending upon the course of snow-melting in time and upon its intensity, the forest's effect on the spring flood's formation

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and height is manifested differently: in one case it leads to high intensity of shedding of thaw waters from the forest and low from the field, in another to identical intensities, etc.

In conditions of a lingering spring, the snow cover in fields slowly disperses, principally under the action of solar radiation. In the forest, however, theprincipal snow mass still remains by the time the fields are clear, and its further thawing proceeds in the presence of high air temperature, which evokes high intensity of snow-melting. For rivers whose basins are about 50 percent wooded, the course of the flood in a spring of this type is characterized by two peaks, the first formed by the "field" and the second by the "forest" thaw waters. In these same rivers a more rapid and continuous thaw stipulates a somewhat prolonged flood with a high peak which is lower than in rivers with solidly forested basins.

The effect of a forest on the height of the flood, depending on spring weather conditions, might be further demonstrated by a series of examples. But these examples can to no extent exhaust the whole variety of conditions of snow-melting and shed of thaw waters which are observed in nature. It is possible to ascertain this effect only on the basis of analysis of a long series of observations, which would afford the most reliable determination of the probability of average snow-melting conditions. But this kind of research, with its considerable consumption of labor and the nature of the raw factual data, presents itself as a task of extraordinary complexity if one takes into account that the effect of the forest is veiled by many other factors.

However, we have tried, if only approximately, to illustrate

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with factual observation materials the correctness of the thesis set forth above concerning the nature of influence of a basin's forestation on the flood maximum.

For fulfillment of this task it would have been necessary to select a sufficient number of basins located in similar physico-geographical conditions andhaving, in addition to approximately equal areas, different degrees of forestation and relatively long series of observations; but with such a statement the task would be unrealizable, since holding to these demands it is impossible to select similar basins with a different degree of forestation (in limits from 0 to 100 percent) in one rayon. Therefore, we had to use data on rivers of the Oka basin, the basin of the Volga from the Shcherbakovskiy reservoir to the mouth of the Kama, the Kama basin and a small number of rivers in the upper parts of the Sozh, Desna and Don basins.

On the whole, observations at 212 alignments were used, distributed over 123 rivers with basin areas from 50 to 50,000 square kilometers.

In the attached table the distribution of areas of the basins entering into the investigation and the periods of observation of the flow in them are given. As is seen from this table, basins with F = 1001 - 5000 square kilometers predominate; they are also, on the whole, the ones which are characterized by the greatest duration of observation -- 65 percent of them have been under observation for more than 10 years.

[See Table on following page]

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TAPLE 1

Distribution of Pasin Areas and Periods of Cbservation of Flow in Them

Basin Area in Square Kilometers	Number of Stations		Number of Stations with Duration of Cbservation (Years)					
	Number	Percent	3-5	6-10	11-20	21-30	31-50	50
500	18	9	7	5	6	-	-	-
501 - 1000	13	6	5	2	6	-	-	-
1,001 - 5,000	81	38	10	18	45	5	2	1
5,001 - 10,000	40	19	4	14	17	2	1	2
10,001 - 30,000	49	23	4	10	21	2	4	8
30,001 - 50,000	11	5	1	-	4	1	4	1
Total	212	100	31	49	99	10	11	12

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The essential hydrometrical materials -- the maximum flood-water discharges and their norms -- we copied for the most part from D.L. Sokolovskiy's work "Hydrological and Water-Conservational Calculations for the Designing of Small GES [Hydroelectrical Stations]". Where these data were insufficient they were supplemented from "Hydrological Yearbooks" and "Materials on the River System of the USSR".

As a deficiency in the utilized materials, the different duration and noncoincidence of observation periods in many stations should be noted. With short series of observations, most of the maximum discharges in a considerable number of cases should probably be considered too low, and the norm not always equal or close to the factual, that is, to that calculated from a long series of observations.

Determination of the percent of forestation for 196 basins was accomplished using a transparent sheet divided into squares overlaid upon a map, and for 16 points located in the Dnepr and Don river basins the data were copied from "Proceedings of the Kiev Science-Research Hydrological Observatory," number 3(4), 1949.

As the characteristic of maximum flow, the variation of whose magnitude is being investigated in relation to the variation in forestation of the basin, the parameter A was accepted from D.L. Sokolovskiy's formula ($Q_{max} = AF^{0.75}$) for determination of maximum spring flood discharges. As we know, the parameter A is a summary coefficient characterizing the maximum flood flow. It represents, with a known approximation, the maximum intensity or maximum magnitude of the elementary flow, reduced to one square kilometer and expressed in millimeters per hour or cubic meters per second respectively.

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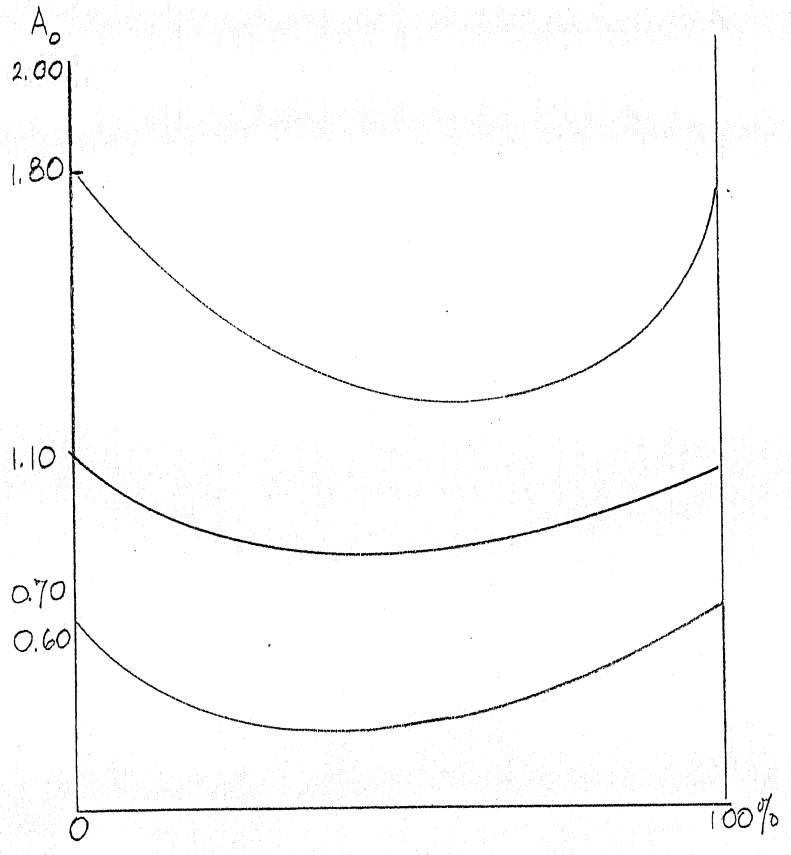
The parameter A is accepted for the reason that, in comparison with other flow characteristics, it excludes the effect of the dimensions of the basin's area upon the height of the flood crest.

For exposure of the nature of a forest's effect on the spring flood height we have constructed a graph with the relative forestation of the basins in percent plotted along the abscissa and the average maximum value of parameter A_0 from D.L. Sokolovskiy's formula, expressed in cubic meters per second, along the ordinate (Figure 1).

FIGURE 1

FORESTATION



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As can be seen from this diagram, almost all the points are distributed along some curve which has a minimum value of parameter A_o when the forestation of the basin amounts to about 50 percent.

The scattering of the points in a relatively wide zone between two curves finds its explanation in the fact that many factors were not taken into consideration nor evaluated in the construction of the graph, to which number belong:

1. the composition and distribution of forest plantings in the river basin;

2. the irregularity in distribution of the snow cover over the territories of the rayon;

3. the number of lakes and swamps;

4. the topography;

5. the soil bases, and other factors.

In addition, considerable dispersion of the points is also explained by the great error in determination of the maximum discharge norms and by the asynchronism of observation periods. But in spite of the fact that all these factors veil the effect of the forest, the dependence of the maximum flood discharge upon the degree of forestation of a basin is clearly enough apparent.

In Figure 2 the same relationship is presented, but in it we have tried to exclude the effect of the snow accumulation, different in magnitude in the basins under consideration, as a purely climatic factor. In this diagram we have accepted the ratio of parameter A to the maximum snow reserves norm H_o (taken from the "Atlas of Maximum Snow Reserves" published by the GGI) as the function being studied. It is not difficult to see that in this case the nature of the relationship appears even more clearly.

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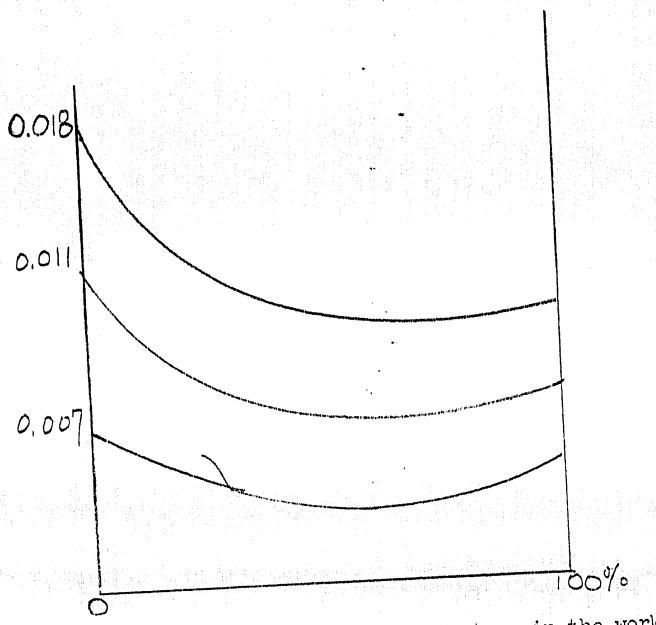
FIGURE 2

FORESTATION



The obtained results are the first stage in the work. Further research should proceed along the path of exclusion of other factors which veil a forest's effect; this will make it possible to ascertain the effect of degree of forestation on maximum flood discharge more accurately. The relationship presented in Figure 2 can certainly not be considered to have been calculated; however, it well illustrates the fundamental thesis that the greatest influence on the lowering of the flood is exerted, not by solid forestation of a basin, but by lesser forestation, close to 50 percent.

Summing up all that has been set forth above, one may make the following conclusions.

1. As a consequence of the nonsimultaneity of snow-melting in field and forest and of the nonsimultaneity of shedding of "field"

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and "forest" waters, a forest's greatest influence in decreasing the maximum flood discharge is manifested in natural conditions with forestation of the basin by close to one half. With variation of forestation to both sides of this value the forest's effect is noticeably decreased.

2. In a continuously forested watershed, as compared to a half-forested one, the flood is more often higher.

Both these statements are correct, certainly, for average snow-melting conditions.

3. All the existing empirical formulas for calculation of the effect of forestation demand re-examination in the light of the discussed theses.

REFERENCES

1. Voyeykov, A.I., Man's Effect upon Nature. State Publishing House for Geographical Literature, 1949.

2. Voyeykov, A.I., The Rivers of Russia, 1882.

3. Rutkovskiy, V.I., The Hydrological Role of a Forest. Goslesbumizdat, 1949.

Declassified in Part - Sanitized Copy Approved for Release 2012/04/23 : CIA-RDP82-00039R000200170026-4

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ANALYSIS OF THE DEVELOPMENT OF LOSSES

N. A. Bagrov

The precipitation which falls on the earth's surface partly evaporates and partly flows off into the seas and oceans in the form of rivers and streams. The part of the precipitation that evaporates is lost to the flowoff, for which reason it is usually described as a loss.

In addition to losses to evaporation, one may distinguish for a single rain another part of the precipitation which is lost through infiltration into the soils and grounds. One may consider that having run a long way under the earth, this part in the long run emerges onto the earth's surface and is incorporated into the flowoff. But for the flowoff of a given rain (or flood) this part of the precipitation may be numbered among the losses.

The process of loss formation is complex and inconstant. We shall examine the mechanism of formation of losses here in only an extremely schematic form, considering the chief role in their formation to be played by surface retention. Under the term "surface retention" we shall comprehend the whole aggregate of causes which hold back the surface flow in one form or another. This aggregate of causes is made up of a whole series of links and begins with expenditure of part of the precipitation in moistening a basin's surface, from the retention of water by small irregularities in the soil and the formation of standing pools and puddles to swamps and lakes inclusive.

Leaving aside infiltration processes and channel processes of

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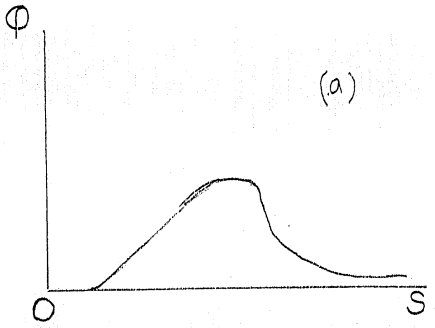
flowoff formation, together with its development in time, we shall make an attempt to characterize statistically all the nondischarging depressions in a basin. For this purpose we shall introduce a certain distribution curve $\varphi(x)$, with the quantity x, representing the layer of precipitation which has fallen at one time, as independent variable. Let us give function $\varphi(x)$ such a meaning that quantity $\varphi(x)dx$ gives the portion of the basin's area which stops retaining precipitation (becomes discharging) with an increase of precipitation from a value x to a value x + dx.

Inasmuch as with a sufficiently great layer of precipitation all the nondischarging areas of the basin fill up and the whole area of the basin yields flowoff, we have the right to write the equality

$$\int \varphi(s)\, ds = 1.$$

It is hardly possible to obtain the distribution function (x) by any kind of direct measurement. One may suppose that in nature we will be dealing with the curve pictured in Figure 1a.



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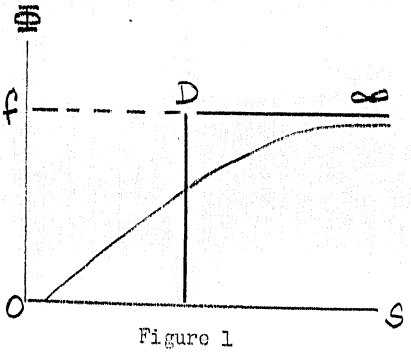

Figure 1

Certainly, this is far from the only possible form this curve can take. It would seem that there can also be curves of another type, with two or several maxima.

Assuming function $\varphi(s)$ to be known, it is easy to obtain the layer of flowoff from a basin, knowing the layer of precipitation x.

In actuality, if x is the layer of precipitation, then flowoff can obviously only originate from those parts of the basin where the surface retention s is less than x. The flowoff layer itself will be x - s. The quantity $(x - s)\ \varphi(s)ds$ will give the layer of flowoff from the elementary area $\varphi(s)ds$ in the conversion to the whole area of the basin.

Consequently, the total layer of flowoff from the whole basin (but not from its whole area) will be:

$$y = \int_0^x (x - s)\,\varphi(s)\,ds \qquad (2)$$

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Taking the difference between precipitation and flowoff, we obtain the layer of losses (calculated for the whole area of the basin):

$$\pi = x\left[1 - \int \varphi(s)\,ds\right] + \int_0^x s\,\varphi(s)\,ds. \qquad (3)$$

The characteristics of formula (2) allow us easily to find function $\varphi(x)$ by way of the derivatives of y with respect to x. In fact, differentiating equation (2) with respect to x, we obtain:

$$y' = \int_0^x \varphi(s)\,ds + (x - x)\,\varphi(x) = \int_0^x \varphi(s)\,ds \qquad (4)$$

and, differentiating once more, we shall have:

$$y'' = \varphi(x). \qquad (5)$$

Differentiating equation (3) in exactly the same way we obtain:

$$\pi' = 1 - \int_0^x \varphi(s)\,ds. \qquad (6)$$

The structure of formulas (4) and (5) allows us to introduce the integral function $\Phi(x)$, which characterizes the basin's surface retention:

$$\Phi(x) = \int_0^x \varphi(s)\,ds. \qquad (7)$$

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With the help of this function equations (2) and (3) are somewhat simplified and take the forms:

$$y = \int_0^x \Phi(s)\, ds, \tag{8}$$

$$\pi = \int_0^x [1 - \Phi(s)]\, ds. \tag{9}$$

The meaning of $\Phi(s)$ is contained in the fact that with a layer of precipitation equal to s the value of function $\Phi(s)$ is equal to that part of the basin's area from which flowoff originates. Flowoff does not originate from the remaining part of the basin because the whole layer of precipitation is retained there. Obviously, if the precipitation layer acquires an increment equal to dx, the flowoff will acquire an increment dy, equal to

$$dy = \Phi(x)\, dx, \tag{10}$$

inasmuch as the incremental layer of precipitation will all flow off from an area equal to $\Phi(x)$.

Hence formulas (8) and (9) are again obtained. Indeed, one might expect this on the basis of all the foregoing inferences.

Function $\Phi(s)$ is a nondiminishing function varying within limits from zero to one. In conformity with Figure 1a, Figure 1b gives the most probable form of the curve $\Phi(x)$. One may form a certain representation of the shape of this curve by analyzing data

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on the volume of the spring flood in relation to snow reserves. In most cases, however, the coarseness of the measurements and the range of variation of the measured values yield almost nothing in this respect. In fact, the usual form of the graph of relation between flood volume and snow reserves is that pictured in Figure 2, the measurement points lying as a rule in the straight-line region represented by the solid line. The dotted part of the curve is not revealed by observation data.

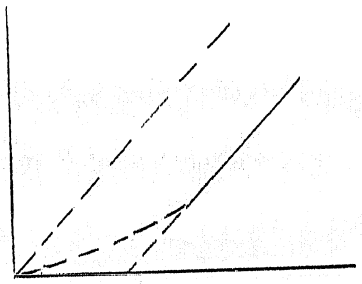

Figure 2

The straight line itself is as a rule inclined somewhat less than 45 degrees to the x axis. The angle of inclination reaches 45 degrees only in exceptional cases. These are observed in treeless, swampless basins with a good flowoff. For the rest of the cases (if one disregards a certain imperfection in methods of distinguishing the spring flowoff) one may assert that the snow reserves do not attain the magnitude necessary for the detection of threshold losses.

Many examples of a similar kind are presented in the work of V. D. Komarov [1], who was one of the first to pay attention to the role of surface retention.

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If we consider that the direct observation (in the case of an inclination at a 45-degree angle) may be extrapolated along the dotted line (Figure 2) to the intersection with the x axis at the point x = a, then curve $\Phi(x)$ will have the form of the broken line Oa - aA - A∞ (Figure 1b). In this case the distribution function $\varphi(x)$ will be everywhere equal to zero except in the region of point x = a, where it will have an infinitely large value if condition (1) is maintained. The latter in this case takes the form:

$$[\varphi(x)\,dx]_{x=a} = 1. \qquad (11)$$

In analysis of the spring flood one is very often obliged to take into account the factor of autumn watering. If one leaves filtration processes aside, then one may say that the role of autumn watering is defined by the fact that the water which is accumulated in autumn decreases the capacity of the nondischarging parts of the basin and thus the flowoff is increased. One may express this idea easily with the help of the formulas cited above. Let us assume that a certain layer of precipitation x_0 has fallen when (for example, in autumn) all the nondischarging parts of the basin were free of water. The subsequent layer of precipitation x (which may be thought of as the inflow of water from thawing snow) falls under conditions of partial or complete fullness of the nondischarging parts. The flowoff from this latter layer of precipitation will be determined by the formula:

$$y = \int_0^{x+x_0} \Phi(s)\,ds - \int_0^{x_0} \Phi(s)\,ds = \int_{x_0}^{x_0+x} \Phi(s)\,ds. \qquad (12)$$

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The losses in this case take on the expression:

$$\Pi = \int_{x_0}^{x_0+x} [1 - \bar{\Phi}(s)]\, ds. \qquad (13)$$

Obviously, the magnitude of losses in the presence of previous moistening may decrease very sharply and may even be reduced to zero if function $\bar{\Phi}(x)$ is taken in the broken-line form and x_0 is greater than a.

Until now we have left aside the processes of infiltration of surface waters into the soil and ground. Infiltration is a very important factor in formation of losses. But inasmuch as determination of functions φ and $\bar{\Phi}$ can be accomplished only by way of comparison of flowoff and precipitation data, we are not able to analyze the losses into those to surface retention and those to infiltration. However, one may suppose that infiltration proceeds in the same spots as surface retention. One may assume, moreover, that the seats of infiltration coincide with the seats of surface retention.

Let us now make a hypothesis on the proportionality of infiltration and surface retention.

Let functions φ and $\bar{\Phi}$ give only the surface retention. If the total effect of loss formation is k times as great as the effect of surface retention, then it can be described by means of the functions f(x) and F(x), which are expressed in terms of $\varphi(x)$ and $\bar{\Phi}(x)$ in the following manner.

$$f(x) = \frac{1}{k}\varphi\left(\frac{x}{k}\right), \quad F(x) = \bar{\Phi}\frac{x}{k}. \qquad (14)$$

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In Figure 3 the relationships between functions φ and f, and also between functions Φ and F are shown, with the supposition that k = 2. It is easy to see that in this case the limiting (with x ———) total losses increase k times; with a small quantity of precipitation the losses may increase, although a smaller number of times, up to the full consumption of the precipitation which has fallen. The magnitude of coefficient k can take into account the duration of snow-melting and must increase with increase of the latter.

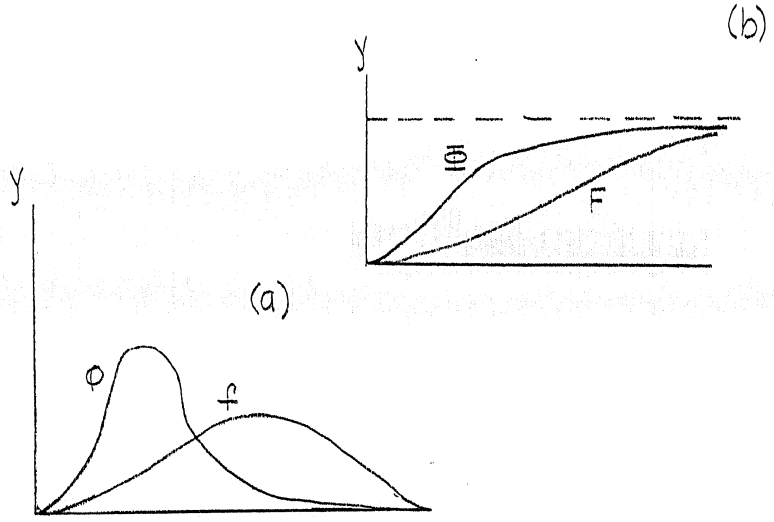

Figure 3

Thus knowledge of either of the functions $\varphi(x)$ or $\Phi(x)$ and of a single coefficient k will enable us to explain the whole multiform and variegated picture of flowoff from falling precipitation.

In conclusion, let us dwell upon one observation. In differential form equation (9) assumes the appearance:

$$d\Pi = [1 - \Phi(x)]\, dx. \qquad (15)$$

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If each term of this equation is divided by the time differential dt, then one may integrate it as a function between intensity of precipitation inflow and intensity of losses. Apparently a simple function is not obtained here (attempts to obtain such a function were made by N. G. Dmitriyeva [2]). It follows with complete definiteness from equation (15) that the intensity of losses for a given intensity of precipitation inflow dx/dt will be the smaller the greater is the over-all sum of water inflow x (from precipitation and from snow melting). N. G. Dmitriyeva's function is obviously based upon a chance coincidence of circumstances.

REFERENCES

1. Komarov, V. D., Study of the Spring Flowoff of Rivers of the Oka Basin. Trudy TsIP, number 4(31), 1947.

2. Dmitriyeva, N. G., Forecasting the Thaw Flowoff Hydrograph. Trudy TsIP, number 9(36), 1948.

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CALCULATION OF SURFACE RETENTION OF WATER IN RIVER BASINS FOR PURPOSES OF FORECASTING THE FLOWOFF

Ye. G. Popov

The basic defect of existing formulas and diagrams for calculation of flowoff "losses" is that in their development the underlying surface has been investigated only from the point of view of its infiltration capacity, but, as is known, the infiltration of water into the soil is only one of the elements in the overall process of retention and losses of water in a river basin.

In the present article attempts are made, on the one hand, to show how great the role of surface retention is, and, on the other, to give general bases for solution of "loss" problems in particular for precalculation of thaw flowoff.

FLOWOFF AND SURFACE RETENTION OF WATER IN RIVER BASINS

The surface of every slope, every elementary watershed in a river basin, represents a system of a multitude of irregularities, from the tiniest hollow between clods of earth up to rather large non-flowoff zones.

This numberless multitude of interconnected or unconnected hollows, microravines and canals is possessed of most diverse areas and depths and, consequently, capacity.

A mass of small ravines and hollows often unite into rather large accumulations of water, which can only begin to flow off when they are absolutely filled up.

Thus, by virtue of the enormous number and extreme diversity

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of dimensions and capacities of the seats of surface retention, the active (in the sense of water discharge into a river) area of the basin cannot remain constant and must increase with the increase of quantity of falling precipitation or in the course of snow melting according to the degree of filling of these seats.

The presence or absence of seepage of water into the soil does not in principle change the indicated situation. Indeed, in ordinary circumstances surface accumulation is only impossible when the intensity of absorption of water into the soil is equal to or greater than the intensity of fall of precipitation. But in this case surface flowoff is also impossible. In all other cases the process of surface retention in each depression will be, figuratively speaking, analogous to the process of filling up a vessel full of holes. The greater the leakage, the longer it will take, with one and the same intensity of inflow, to fill it up, and the greater the quantity of water that will be needed in order to fill it temporarily.

One may assume theoretically that for each basin there must exist a more or less definite and sufficiently stable distribution of the depths of these irregularities and depressions in relation to their area. Strictly speaking, the character of such a distribution should reflect the innate water-discharge conditions of each basin.

To construct these distribution curves for each actual basin seems practically impossible owing to the absence of data on the number, areas and depths of the depressions. Therefore a general or qualitative representation of their character can only be built up on the basis of our representations of the structure of the sur-

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faces of river basins and the character of the soil cover.

In the first approximation the most probable character of the distribution of relative area of depressions in relation to their depths can be thought of as being in the form of a unimodal curve or in the form of an exponential curve, although in a series of cases the distribution curve may also have a considerably more complex character.

For a water-impermeable basin, the layer of precipitation or store of water in snow which brings about the filling of each given depression is naturally equal to its depth. Consequently the curve of distribution of the relative areas of the depressions, with calculation of their depths, at the same time represents, for a water-impermeable basin, the curve of distribution of the active (in the water discharge sense) areas of the basin in relation to the integral sum of fallen precipitations or the layer of melted snow.

Even if we do not know the true character of this distribution, it can be theoretically determined by the following general condition (proposed by N. A. Bagrov):

$$\int_0^{S\to\infty} \varphi(S)\,dS = 1, \qquad (1)$$

where $\varphi(S)$ is some function of the distribution of the depressions in relation to the layer S which fills them, which is equal in the case of a water-impermeable basin to the depth of the depressions themselves.

In physical origin, $\varphi(S)dS$ must represent the relative part

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of the basin's active area on which, with the given layer of water, all the seats of surface retention have been filled with water and can hold it back no longer.

Expression (1) implies that the entire area of the basin can be active (discharge water) only with an extremely large layer of water, when all the water-catching irregularities in the relief can be filled up and begin to discharge. With smaller values of the layer of water forming in the basin, some part of the basin's area is in a position to hold it back and thus to remain nondischarging. This area will obviously be the greater the smaller the layer of water which has fallen into the basin.

This theoretically strict expression is also correct for the case of a water-permeable basin, with this one difference: that the layer necessary to fill any depression will in this case be the greater, the greater the speed with which the water soaks into the soil.

For the case of a constant infiltration speed i = const and a constant intensity of snow-melting (fall of precipitation) h =const, the layer S_i necessary to fill a depression must be equal to:

$$S_i = \frac{H}{1 - \frac{i}{h}} \qquad (2)$$

where H is the depth of the depression.

But since for a water-impermeable basin the depth of a depression H is equal to the layer necessary to fill it (H = S), expression (2) may be rewritten in this way:

$$S_i = \frac{S}{1 - \frac{i}{h}} \qquad (3)$$

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Obviously, expression (1) in this case takes the form:

$$\left(1-\frac{i}{h}\right)\int_{0}^{S\to\infty}\varphi(S)\,dS=1. \qquad (4)$$

It follows from expression (4) that with i = const and h = const the distribution curve of the active area of a water-permeable basin must be similar to the distribution curve formed on the supposition that it is impermeable.

Expressions (1) and (4) are fundamental and highly important computational characteristics of the water-retentive capacity of a river basin.

Now let us analyze the theoretical bases of the calculation itself.

BASES FOR CALCULATION OF WATER ABSORPTION IN A RIVER BASIN

Of a given layer of water x which has fallen on a basin, the total quantity P_a which is held back by the basin, if it is water-impermeable, must obviously be made up of the quantity of water which has gone into the filling up of those depressions whose depth is less than the given layer x, which quantity is equal to the holding capacity of these depressions P'_a, and the quantity of water P''_a which is consumed in the partial filling of the deeper depressions. In other words,

$$P_a = P'_a + P''_a . \qquad (5)$$

Designating as f the active (discharge-yielding) part of the basin, on which for a given layer of fallen water x all the depres-

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sions have been filled up, and the nondischarging part of the basin's area as F - f, and expressing the total quantity of retained water in millimeters of a layer, we may write:

$$P_a = \frac{fP'_a}{F} + \frac{F - f}{F} x \,. \tag{6}$$

On the basis of expression (1) the first term of equation (6), which is equal to the capacity of the filled depressions, must be equal to:

$$\frac{f}{F} P'_a = \int_0^{S=x} S \varphi(S) dS. \tag{7}$$

The part of the basin's area which is nondischarging for a given x must, on this same basis, be equal to:

$$\frac{F - f}{F} = 1 - \int_0^{S=x} \varphi(S) dS. \tag{8}$$

Substituting (7) and (8) into (6), we obtain a general expression for calculation of the total layer of water retained by a water-impermeable basin in relation to the total quantity of water which has entered the catchment area:

$$P_a = \int_0^{S=x} S \varphi(S) dS + \left[1 - \int_0^{S=x} \varphi(S) dS\right] x, \tag{9}$$

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It follows from equation (9) that when the layer x of melted snow or fallen precipitation is sufficiently large, the total surface retention of water by a river basin must depend on it extremely slightly, since when $x \longrightarrow \infty$ the size of the relative area on which retention takes place converges, according to expression (1), toward zero:

$$\left[1 - \int_0^{S=X} \varphi(S)\,dS\right]_{\text{with } X \to \infty} \to 0. \qquad (10)$$

Under these same conditions the second item in equation (9) must converge toward a constant magnitude. The physical limit of this magnitude for a water-impermeable basin is the total capacity of all the water-retaining elements of the given basin's relief.

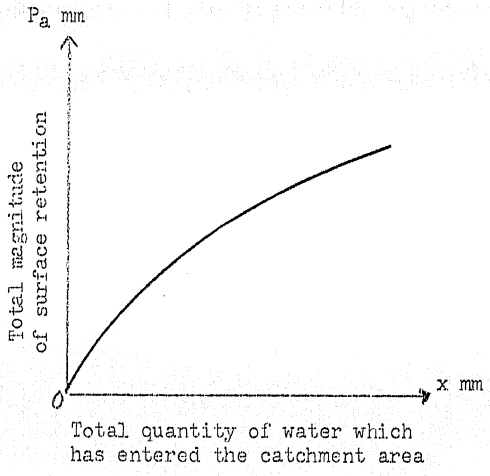

Figure 1. General form of the function $P_a = f(x)$ for a water-impermeable basin

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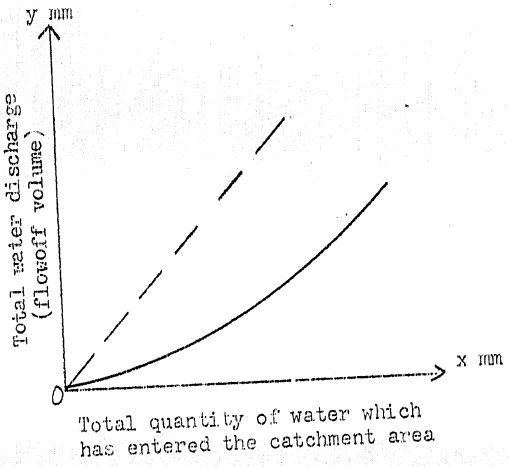

Figure 2. General form of the function y = f(x) for a water-impermeable basin

The general character of the variation of magnitude of water retention in dependence upon total quantity of water coming into the catchment area is thus, for a water-impermeable basin, the simple function $P_a = f(x)$. This function, on the whole increasing, must at first rise rather sharply and then slowly approach its limit (Figure 1).

In conformance with this, the total flowoff as a function of the same quantity x (in other words, the flood volume as a function of the maximum snow reserves or of the sum of precipitations) must also be a simple function in the given case, $y = f(x)$. In fact, knowing that $y = x - P_a$, and substituting the value of P_a from equation (9), we shall have:

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$$y = x\int_0^{S=x} \varphi(S)\,dS - \int_0^{S=x} S\varphi(S)\,dS. \qquad (11)$$

It follows from this expression, and also from expression (1), that with increase of x the total flowoff (water discharge) must increase continuously, at first slowly and then more sharply (Figure 2).

With sufficiently great values of x, when the active area $\int_0^{S=x} \varphi(S)dS \to 1$, and the expenditure of water in surface retention tends toward its limit $\int_0^{S=x} S\varphi(S)dS \to N$, the curve of the total water discharge or over-all flowoff function approaches a straight line parallel to the bisector of the coordinate angle.

For water-permeable river basins the simple functions $P = f(x)$ and $y = f(x)$ cannot apply, since water in this case is expended, not only in filling irregularities in the microrelief, but also in soaking into the soil. Thus for the simplest case, when the intensity of soaking through and the intensity of snow melting or fall of precipitation are constant, the expressions for the total absorption layer and the total flowoff layer take the following forms:

$$P = \int_0^{S=(1-\frac{i}{h})x} S\varphi(S)\,dS + \left[1-(1-\frac{i}{h})\int_0^{S=x}\varphi(S)dS\right]x \qquad (12)$$

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and

$$y = x\left(1-\frac{i}{h}\right)\int_0^{S=x}\varphi(S)\,dS - \int_0^{S=\left(1-\frac{i}{h}\right)x} S\,\varphi(S)\,dS, \qquad (13)$$

where i is the constant infiltration intensity in millimeters per specified unit of time, and h is the constant intensity of precipitation fall or snow melting in the same units.

As is apparent from expressions (12) and (13), the total absorption and the total flowoff are in this case functions of three variables, x, h, and i. However if one takes into account the fact that the infiltration intensity is itself a function, primarily of x, then it becomes clear that these functions may in the long run be reduced to functions of two variables. The difficulty in derivation of such functions for calculation lies at the present time in our insufficient knowledge of the laws of infiltration.

Graphically, the total water absorption function (12) for each constant value of i is represented by a family of curves, each of which corresponds to a given value of i/h and all of which increase with increase of x.

In exactly the same way the total flowoff function (13) is represented by a family of curves, each of which corresponds to a definite and constant value of the ratio i/h (Figure 3).

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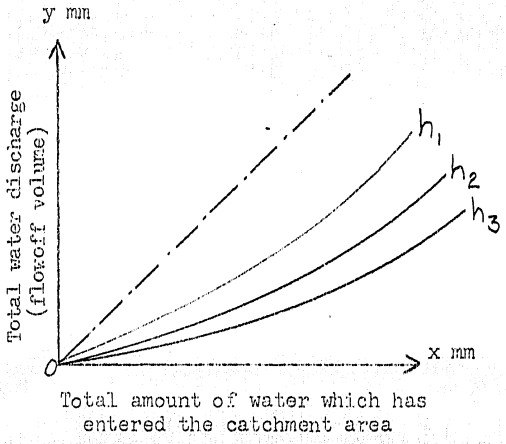

Figure 3. General form of the function y = f(x, h) for a constant value of infiltration velocity, i = const.

In order to obtain a general expression for the intensity of surface absorption of water in a basin, let us differentiate expression (9) with respect to time and we shall have:

$$P_a = h\left[1 - \int_0^{S=\int_0^t h\,dt} \varphi(S)\,dS\right]. \qquad (14)$$

It is easy to see that the quantity of water which is retained by a water-impermeable basin in a unit of time is proportional to the intensity of water inflow and depends on the total quantity

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of water which has entered the catchment area. The coefficient of proportionality at h, which may be called the coefficient of surface retention, is equal to:

$$k_i = 1 - \int_0^{S=X} \varphi(S)\,dS \qquad (15)$$

and is itself a function of the integral sum of precipitations.

Differentiating equation (11) with respect to time we obtain a general expression for the basin's water-discharge intensity:

$$y = h \int_0^{S=X} \varphi(S)\,dS, \qquad (16)$$

which for a water-impermeable basin is the calculational equation we were seeking.

The coefficient of proportionality at h, which in the given case may be called the water-discharge coefficient is

$$\eta' = \int_0^{S=X} \varphi(S)\,dS, \qquad (17)$$

and is itself a function of the total quantity of water which has entered the basin.

Performing analogous operations for the case of a water-permeable basin, with the conditions that i = const and h = const, we obtain corresponding equations, which have the form:

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$$p = h\left[1-(1-\frac{i}{h})\int_0^{S=X}\varphi(S)\,dS\right], \tag{18}$$

$$y = (h-i)\int_0^{S=X}\varphi(S)\,dS, \tag{19}$$

$$\eta = (1-\frac{i}{h})\int_0^{S=X}\varphi(S)\,dS. \tag{20}$$

Let us now dwell for a short time on the question of average intensity of water absorption by a river basin for the entire period of snow melting or rainfall. This question is of interest for two reasons. First, because one attempt at calculation of this characteristic for real river basins using data on average intensity of snow melting is already known in the literature [1], and second, because this characteristic is the easiest to obtain from the data of ordinary hydrometeorological observations.

For derivation of this function for conditions of a water-impermeable basin let us divide both sides of equation (9) by time $T = \frac{x}{h_{avg}}$; then we obtain:

$$P'_{arg} = \frac{h_{avg}}{x}\int_0^{S=X}\varphi(S)S\,dS + h_{arg}\left[1-\int_0^{S=X}\varphi(S)\,dS\right]. \tag{21}$$

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It is apparent from this equation that the average intensity of surface retention of water by a river basin is directly proportional to the average intensity of snow melting or rainfall h_{avg} and inversely proportional to the total store of water in snow x, remaining simple for any of their values. For a series of constant values of x, equation (21) is graphically expressed as a cluster of straight lines issuing from the origin of the coordinate axes.

Taking the value of infiltration intensity to be constant (i_{avg} = const), it is easy to obtain an analogous expression for conditions of a water-permeable basin:

$$p_{arg} = i_{arg} + (h_{arg} - i_{arg})\left[1 - \int_0^{S=x} \varphi(S)\,dS\right] + \frac{h_{arg}}{x} \int_0^{S=(h_{arg}-i_{arg})T} \varphi(S)\,S\,dS. \qquad (21)$$

It is apparent that in the given case the function $p_{avg} = f(h_{avg} i_{avg} x)$ is simple for any values of the arguments which enter into it and is graphically represented, for a constant value of i_{avg}, by a cluster of straight lines which intersect at one point, corresponding to $p_{avg} = i_{avg}$.

The altogether strict equations (21) and (22) demonstrate the incorrectness of the conclusion obtained in the above-mentioned work [1], where function $p_{avg} = f(h_{avg})$ is expressed in the form of a unimodal curve.

We have already pointed out that it does not seem possible to obtain the factual data necessary for construction of the distri-

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bution curve of active (in the water-discharge sense) areas. However, there is another, indirect, method for solution of the problem which interests us -- the method of utilization of the many-years' data of hydrometeorological observations. This method, which is broadly applied in hydrology, may be considered to be the only one possible at present in the given case.

In fact, let us analyze the general expression for total flowoff:

$$y = x\int_0^{S=x}\varphi(S)\,dS - \int_0^{S=x}\varphi(S)S\,dS. \qquad (23)$$

In this equation the distribution function $\varphi(S)$ is considered to take into account not only the purely geometrical holding capacity of the river basin's surface, but also its infiltrational characteristics.

Theoretically, the distribution function of active areas $\varphi(S)$ can be found by differentiation of equation (23) with respect to x. The first derivative of this expression is

$$\frac{dy}{dx} = \int_0^{S=x}\varphi(x)\,dx. \qquad (24)$$

It is easy to see that the obtained expression represents none other than the coefficient of water discharge, that is

$$\frac{dy}{dx} = \eta, \qquad (25)$$

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whence

$$\frac{d\eta}{dx} = \frac{d^2y}{dx^2} = \varphi(x). \qquad (26)$$

Thus the problem of calculation of water absorption in a river basin, not only in its summary expression, but also in time, is solved, essentially, by plotting sufficiently reliable functions $y = f(x, h, i)$. For the calculations themselves knowledge of the distribution function $\varphi(x)$ is not essential, which follows from equation (25).

The practical method for calculation of flowoff may thus be reduced to the following stages:

(1) construction from observation data of the integral curve or family of curves of flowoff volume $y = f(x)$ or $y = f(x, h, i)$;

(2) construction of the curve of the water-discharge coefficient as the function $\eta = f(x)$ or $\eta = f(x, h, i)$ by way of differentiation of the functions $y = f(x)$ or $y = f(x, h, i)$.

In the first plotting the question of the integral characteristic of water absorption is solved by itself. To accomplish this one may use the usual integral characteristics of water reserves in snow or of quantity of fallen precipitation and also data on the volumes of the high-waters or rain floods. However, one should have it in mind in addition that as a rule these data do not suffice to reveal the very important lower part of the curve $y = f(x)$, and this creates an additional difficulty.

Differentiation of the obtained integral flowoff curve $y = f(x)$

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or family of curves $y = f(x, h, i)$ encounters no principle difficulties and can easily be accomplished by the graphic method. Calculation of the water discharge, however, must be conducted using the equation

$$y = h\eta(x), \qquad (27)$$

where h is the quantity of water in millimeter layers which has entered the basin per specified unit of time, and $\eta(x)$ is the coefficient of water discharge which is obtained in relation to the integral sum of water which has entered the basin.

The proposed method for calculation of water absorption in a river basin was checked by the example of the Visher River at Mitrakovo and gave fully satisfactory results.

The relationship obtained for this basin between the average water-absorption intensity and the average intensity of snow melting and total stores of water in the basin -- the sum of the maximum stores of snow-water and liquid precipitation during the flood period (the number near the points [i.e., the small circles in Figure 4]) is presented in Figure 4. The character of this function fully conforms to the theoretical inference.

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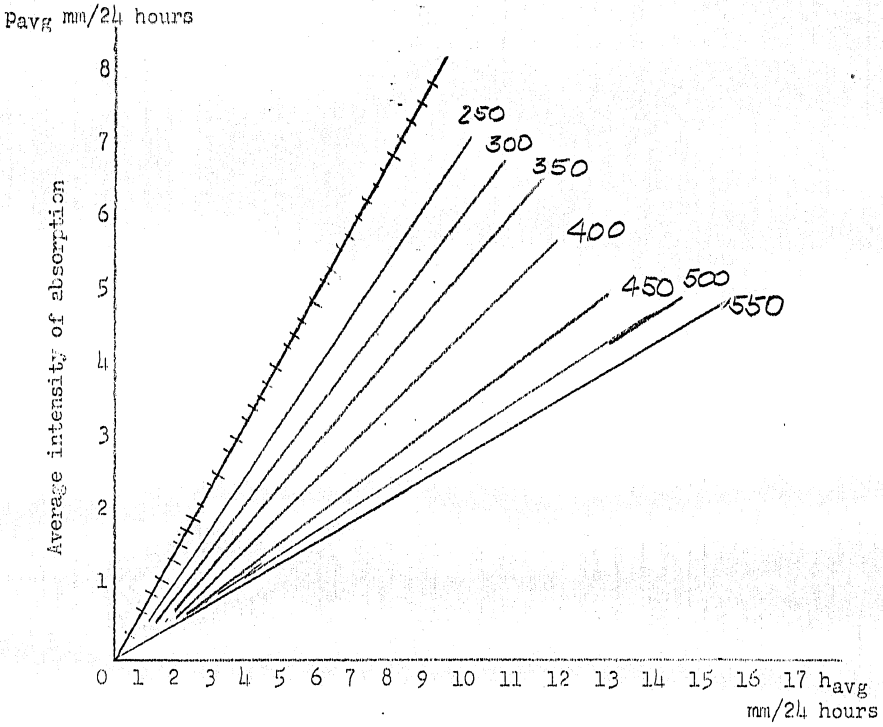

Average intensity of admission of water into the basin, taking into account the fall of liquid precipitation

Figure 4

As an illustration, comparisons of the factual and calculated hydrographs of the spring flood for the same river are presented in Figure 5.

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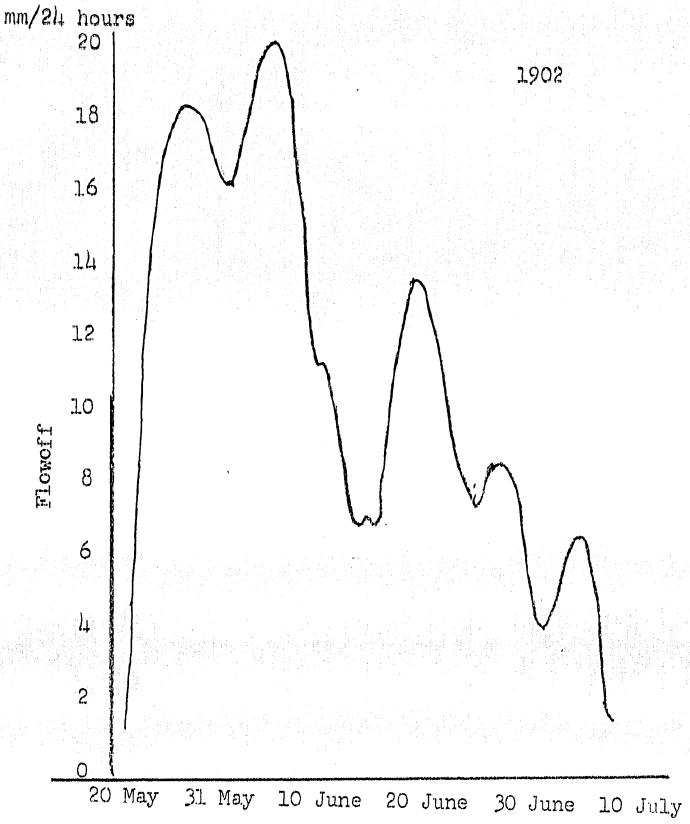

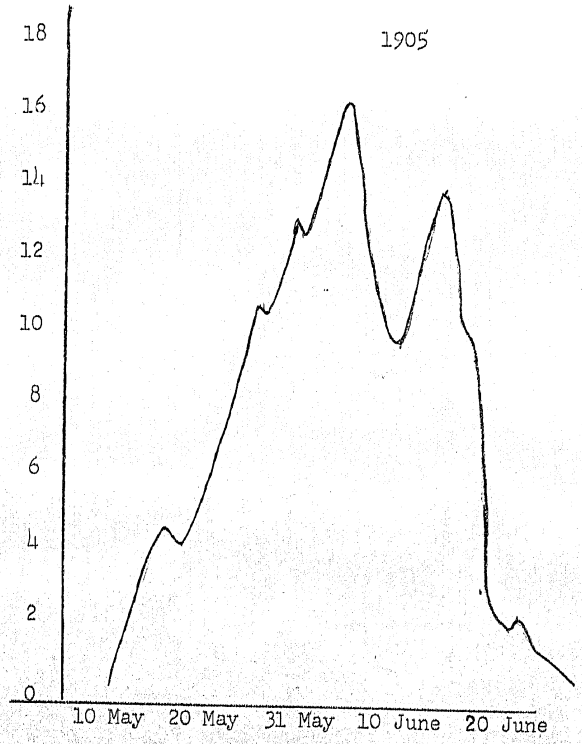

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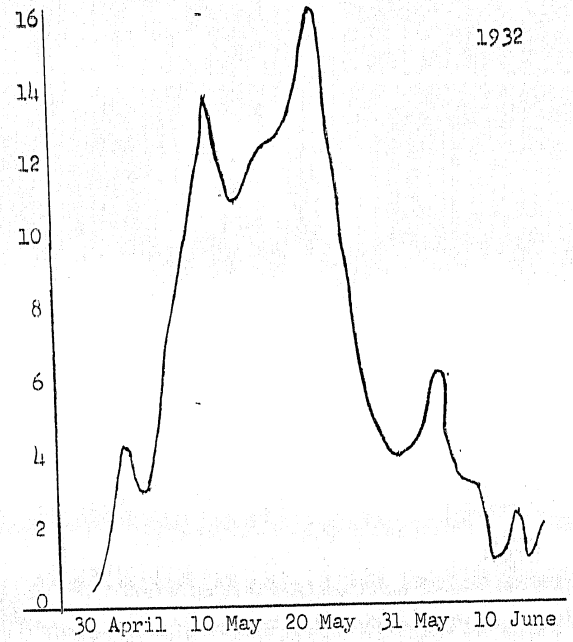

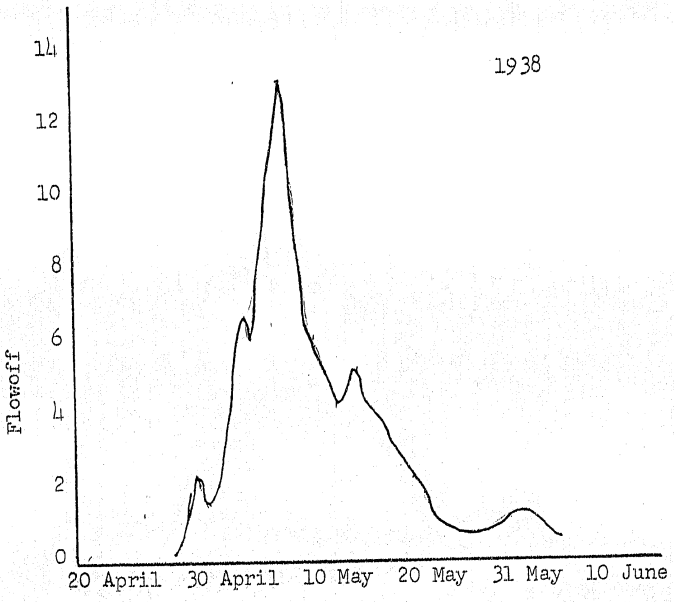

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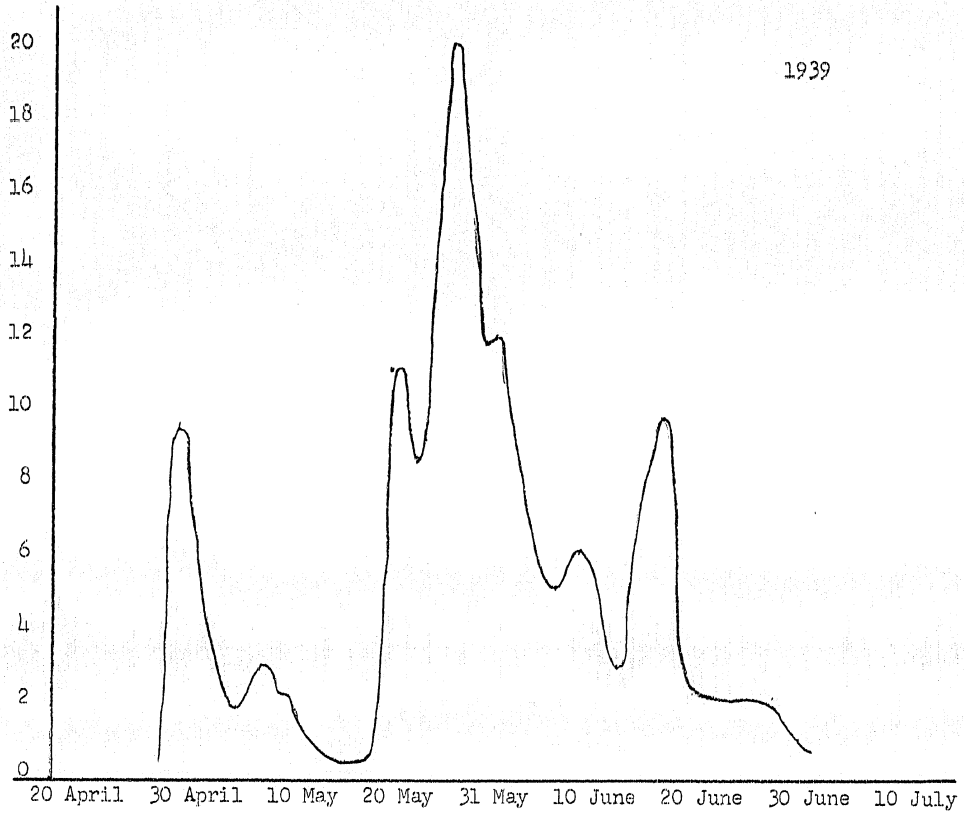

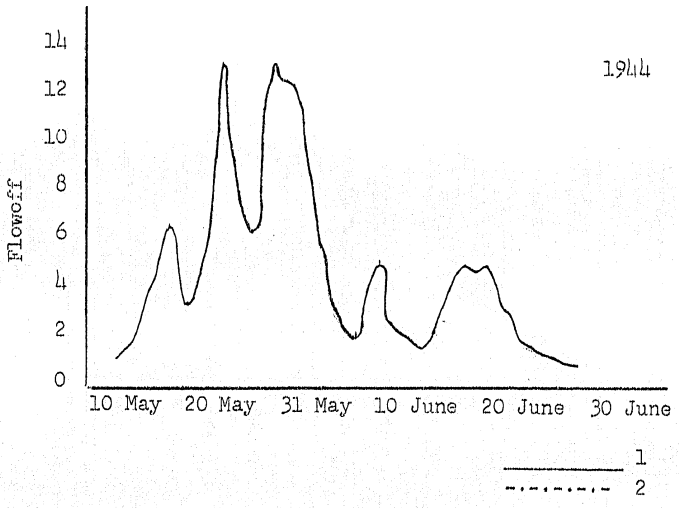

Figure 5. Calculated and actual hydrographs of the spring flood in the Visher River at Mitrakovo

1 - actual; 2 - calculated

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REQUIREMENTS FOR SETTING UP HYDROMETEOROLOGICAL OBSERVATIONS AT SEA

N. A. Belinskiy and
Yu. V. Istoshin

Existing methods of both hydrological and meteorological forecasting are based in the majority of cases on the analysis and appropriate processing of observational materials. Poor quality of raw materials cannot be blamed upon the quality of the forecasting methods. Consequently, in order correctly and effectively to assure our national economy of hydrometeorological information and forecasts, it is first of all necessary to establish observations on the seas and their shores correctly and well.

The quality of observations depends first on the preparation of personnel for stations or expeditions and on the quality of the appropriate instruments. However, it is not necessary to dwell here upon these questions, which are given full enough exposition in a series of instructions and handbooks. It is more expedient to examine only the important and principal, from our point of view, problems of the conduct of hydrometeorological observations at sea which have arisen with especial acuteness in connection with the scientific development of marine forecasting methods.

Analysis of existing hydrometeorological materials convinces us that in many cases they prove to be either insufficient or entirely useless for exploitation by marine forecasting methods. At least two causes of this situation may be pointed out: (1) the absence of due purposefulness in the setting up and conduct of observations at sea; (2) the imperfection of observational methods and apparatus.

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In fact, the participants in an expedition very often have no clear idea of how or for what the materials obtained as a result of observations will be used; in the majority of cases the objective of observations and of expeditionary research in the first place has been compilation of a very general representation of the hydrological regime of a sea.

A great deal of capital is often expended on the solution of particular problems of applied oceanography, whereas with correct organization of the exploratory projects it would be possible, with the drawing in of modest auxiliary measures, to organize broader investigations. In practice, different departments are often carrying on parallel research projects in the same sea region, on which, naturally, too much capital is being spent unproductively.

The absence of purpose and imperfection of methods of observation and instruments brings about such a situation in the study of the sea's character as hinders our further forward progress, especially in the realm of development of methods of marine forecasting. Here we have in mind the scourge of oceanographic research -- its episodicity, seasonality. Actually, the majority of expeditionary observations at sea are conducted in the summertime; the autumn and winter regimes are considerably less fully elucidated, and very few observations are yet available for extreme weather conditions, that is, just those observations which are especially important for obtaining a correct and complete representation of the sea's regime and for the development of forecasts.

If every visit of a research ship to some ocean or sea region in the past has yielded observation materials of exceptional value,

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then now, when in the first approximation the question of what is observed on oceans and seas, what phenomena may be encountered in one or another marine zone, may be considered solved for the overwhelming majority of cases, the expenditure of capital for separate, episodic observations is not justified. Right now a more complex problem has arisen before researcher-seafarers -- investigation of the phenomena and processes which take place in the ocean and seas, above all their variability in time.

To this one must add the necessity for definition of their mutual interconnections and also for clarification of the interdependence between the processes which take place in the sea and those which are observed in the atmosphere above the sea and above its shores. In other words the investigators' goal is to make [our knowledge of] the general physical regularities more precise for concrete geographical conditions. But the new problem demands new methods for its solution and consequently also new methods of observation.

Let us examine, for example, how things stand with the study of marine currents. It is known that the drifting current theory cannot by far always be used in pure form for calculation of the currents in this or that region of a sea, given the wind. At once there arises the necessity for derivation or correction of all the coefficients which relate the current of the given sea zone to the wind which gives rise to it. Turning to the materials of observation of the currents, we discover them to be useless for the purposes indicated. Why at best the few 24- or 12-hour stations selected for observation of currents in a given sea region are as a rule operated only in calm weather. It is altogether obvious that these

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episodic current measurements, performed in the absence of wind or with faint winds, cannot be utilized for construction of the relationships and determination of the essential wind coefficients. These observations are of use only for approximate current characteristics, chiefly ebb-flow characteristics; for complete analysis of nonperiodic, drifting currents they are useless. How, then, do we establish observations of the currents? Two ways are possible: (1) either the observations must be continuous in time and carried on over a comparatively protracted period, which is impossible without broad introduction of machines into oceanographic practice, (2) or observations must be set up to conform with established characteristic conditions of the wind regime, that is, for different directions and velocities of wind, including high velocities.

Generally speaking, the first way has the advantage over the second. With the carrying-out of protracted, continuous observations of currents, features of the regime are brought to light which may be overlooked in isolated observations; protracted observations, made under various conditions, allow us to make a detailed harmonic analysis of the ebb-flow currents, etc. However, depending upon certain conditions, the second method may be preferred, for example in deep regions of tideless seas in a period of more or less fixed wind regime. In this case the setting up of self-recorders is made difficult on account of the great depths; the monotony of the wind field, on the other hand, makes all-round study of the currents difficult. Under such conditions one must willy-nilly resort to observations from ships working for a more or less protracted period in fixed regions of the sea.

The state of affairs is analogous with other elements of the

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regime. The haphazardly conducted observations of temperature and salinity do not allow us to form a representation of the temporal variations of the thermal and saline sea regimes. More than that, such observations are not always in a condition to throw light upon the regime of any considerable area of the sea even during that time interval when they are carried on.

The haphazard observations, among which are even the so-called hydrological surveys of a sea conducted once or twice a year, are especially intolerable in the case of a sea which has been rather well statistically studied. These observations can add very little to our knowledge of the regime of such a sea, and the majority of them involve a completely unnecessary expenditure of capital. We do not here intend to deny the necessity of a similar kind of hydrological survey for special purposes, for example for the needs of the fishing industry at characteristic times in its business, at the spawning time of the herring, etc. Nevertheless, we take the liberty to assert that even in this case it is better to organize matters in such a way that the network of hydrological cross-sections include the basic standard cross-sections plus a certain number of sections or stations essential for a fuller and broader spatial elucidation of the hydrological regime of the given sea region. In the future, observations at the standard sections included in the special survey should be conducted regularly throughout the year. We think that the State Oceanographic Institute and the Oceanology Institute of the Academy of Sciences have done very little to put right the study of temporal variations of the regimes of oceans and seas in limiting themselves to the conducting of episodic expeditions. This idea has similarly not become leading in a series of marine observatories, primarily in the Vladivostok

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Observatory.

It may seem superfluous in our time to speak of the necessity for taking standard hydrological cross-sections of a sea. However, the enthusiasm for episodic marine surveys to the detriment of systematic observations compels us to dwell upon this question once more.

It seems to us imperative that compulsory and regular observations be conducted at standard hydrological sections, specified once in many years. These observations should be performed at least monthly and preferably on the same date [day of the month]. Surely, with monthly observations of the hydrological factors at standard sections one may plot graphs of the yearly cycle of these factors and then with the help of these graphs quote the values of the hydrological factors for any date. But it is nevertheless better as far as possible not to resort to this or any other procedure to avoid the usual errors associated with any deduction, but rather to conduct observations at a specified period of the month, let us say in the first week of every month. The frequency with which these observations should be conducted cannot be standard for all seas and all regions. It should be determined in relation to the temporal stability of the hydrological regime in each region. The less stable the hydrological regime in time, the more often should observations at hydrological sections be conducted. In this connection it will not be superfluous to dwell upon the given question at somewhat greater length.

In practical oceanology the frequency of observations at sea is determined on the basis of formal considerations. Let us say

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that upon no adequate basis a monthly interval is fixed between observation periods at hydrological sections. Let us illustrate this with an example: when it is a question of air temperature the characteristic temperature for a month is taken as the average temperature of the month, which is derived as the average of the average daily temperatures, which are in turn averages of standard observations. These calculations are necessary because it is impossible to use the separate observations or even some of them as the characteristic air temperature for the month. In oceanography the question, to what degree can the temperature and salinity of water be characterized by one observation per month, has as far as we know not even been posed. It goes without saying that on the strength of the great hydrological inertia of water masses, daily or more frequent observations at sea are not required, but with no special quantitative investigations at all for various physico-geographical conditions it is impossible to solve this question.

In the first place, as it seems to us, it is essential for this purpose to utilize materials of hydrological observations at standard sections which have been performed on certain seas with increased frequency, for example every ten days. If these materials turn out to be insufficient for the full solution of the problem, then special research aided by self-recorders should be set up. Particularly great interest was presented by the deep-water observations which were regularly conducted every ten days by the Umb station in the White Sea in its time, but this was subsequently discontinued.

One may say beforehand that such more frequent observations should be conducted in the transitional seasons of the year, when

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the inflexion points of the curves of the annual cycle of the hydrological elements are ordinarily observed.

A great defect in ice observations is constituted by the fact that in them such elements as width of land floe, drift of ice and others are determined by eye. On account of the inaccuracy and subjectivity of visual observations, their utilization for construction of the corresponding functions is often made extremely difficult, and is sometimes even simply impossible.

The defects of visual observations are further aggravated by frequent alteration of instruction on the performance of these observations. The time came long ago to convert to instrumental observations of elements of the ice regime of a sea. We see no difficulty at all in utilization of range finders and goniometers for determination of width of land floe, drift of ice along the shore, etc. Special apparatus may also be used in determining ice thickness. Without instrumental observations of ice it is impossible to raise the quality of ice observations, and without this it is impossible to expect a notable improvement in the quality of ice forecasts.

All that has been said pertains equally to observations of turbulence. Up until the most recent times shore and ship stations in the majority of cases performed, not observations of wave elements, but visual determinations of the degree of turbulence in balls. Now it is time to reject ball estimations of turbulence entirely and to convert to observations of wave elements.

We should dwell in passing upon one question which is of exceptional significance for effective service to the national

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economy on the part of the organs of the Hydrometeorological Service. We have in mind the concentration of hydrometeorological observation materials obtained by other departments in a single center. A special resolution on this question was at one time passed, conferring the function of systematization of these materials upon the Hydrometeorological Service. However, certain departments evaded, on one or another pretext, presentation of materials of expeditionary research in areas concerning marine hydrometeorology to the Hydrometeorological Service (Soyuzmorproyekt [Union Marine Project], the Ministry of Fishing Industry and others).

The lack of concentration of observational materials in one place impedes full and all-round service to the national economy, since the interested organizations are often deprived of the possibility to familiarize themselves with materials obtained on the expeditions of other departments.

A great share of the blame in this matter also rests upon the organs of the Hydrometeorological Service, and in particular upon the State Oceanographic Institute, which up to now has not fulfilled its function as the planning and coordinating organ in the business of hydrometeorological study of the sea.

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SOME RESULTS OF THE SERVICE TO THE NATIONAL ECONOMY RENDERED BY THE MARINE FORECASTING DIVISION OF THE CENTRAL FORECASTING INSTITUTE DURING RECENT YEARS

P. P. Nikiforov

In recent years the Marine Forecasting Division of the Central Forecasting Institute has taken part in special service to certain branches of the national economy. For this purpose one or several co-workers were selected and departed for certain seas.

The first example of such service, not from the center, but on the spot where work was conducted, was the organization of an oceanographic group within the staff of the special hydrometeorological bureau of the GUGMS [Main Administration of the Hydrometeorological Service] on Sakhalin. Hydrometeorological service for the spring herring fishing season in the waters southwest of Sakhalin entered into the task of the bureau as a whole and the oceanographic group in particular. Included in the staff of the oceanographic group were Senior Scientific Co-worker Istoshin (TsIP) [Central Forecasting Institute], leader of the group, Engineer-Oceanologist Cherezsel'skiy (Arkhangel'sk UGMS), and attached to it in addition were Junior Scientific Co-worker Sirotov (GOIN), Senior Scientific Co-worker Pakhomova (GOIN), Junior Scientific Co-worker Gershanovich (GOIN), Senior Technologist Radayev (Vladivostok UGMS) and six student-operators from the Vladivostok Hydrometeorological Technical School.

Preparation for oceanographic work was carried out in close contact with the Sakhalin Division of the Pacific Ocean Institute of

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Fishing Economy and Oceanography (Sakhtinro) which designated specialists to help the group conduct expeditionary work (Sakhtinro Oceanologist Linberg and others). Sakhtinro's director, Professor Probatov, provided general scientific guidance for the group's work. The extent and nature of oceanographic works was defined by a plan approved by VNIRO (Moscow).

Great help was rendered to the oceanographic group by Akimenko, Chief of the Kholmsk Hydrometeorological Station, and by Semenova, Oceanologist at this same station.

The group's basic assignment was to accomplish expeditionary hydrological works, chiefly with the purpose of clarifying the temperature regime in the trade [fishing] region. The approach of spawning herring toward Sakhalin's western shore in spring takes place in definite hydrological conditions. In the waters southwest of Sakhalin the herring do not approach the zone of the stationary seines when the temperature is negative or close to zero: the shoals of herring going to spawn approach the shores in the streams of relatively warm water in the Tsusimsk current. As a rule, before going in mass numbers toward the shore the herring concentrate in shoals at some distance from it, appearing in the current at a certain time as the object of the so-called active catch.

For determination of the basic paths of the herring shoals directed toward shore to spawn and also of the periods of their approach to the standing seine zone, simultaneous hydrological surveys, not only of the fishing region, but also of the neighboring sections of the open sea, are of great help. Maximum catches were undertaken in the zone of relatively warm water beyond the limits of the three-degree isotherm; herring were not caught in the littoral zone.

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Both in the prespawning period and in the fishing season a new temperature distribution chart of the water in the fishing zone and the open sea regions adjacent to it was drawn up every five days. These charts allowed the shoreward diffusion of the streams of relatively warm water, favorable for fishing, to be traced. The results of hydrological observations at sea conducted from the industry's survey ships and later from the TINRO's exploratory steamer "Explorer" constituted basic informational materials for a daily report for the guidance of the Ministry and Trust. These data, together with hydrological information from the Hydrometeorological Service's coastal network of meteorological stations and also from the special network of observers organized by Sakhtinro on shore in the fishing region during the entire fishing season, were raw materials for the drawing up of forecasts of changes in the temperature regime of the waters southwest of Sakhalin. Professor Probatov, Director of Sakhtinro, applied the informational data and the indicated prognostic deliberations with great success to the solution of ichthyological problems. The results of hydrological observations allowed the fishing season staff to draw a series of operational conclusions.

Thus in the very beginning of the fishing season, owing to the presence of cold water in the littoral zone of the territory of the southern fish combines of Sakhalin's western shore, the herring did not approach the stationary seine zone, whereas in the open sea the drifter nets caught fish in considerable numbers. The fishing season staff was given the forecast that the unfavorable situation in this region would last at least three more days. True, this forecast was given such a short time in advance that it did not

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allow for preparation of a significant rearrangement of the industrial forces, although some steps were undertaken on this score. Hydrological investigations conducted at the peak of the fishing season from the steamer "Explorer" showed that in the northern Tatar Strait there is a front of cold and warm waters, that is, north of the front (the division line) masses of cold water are located in the sea, while south of the front lie masses of warm water. The co-workers of the hydrological group gave the fishing-season staff the forecast that these cold waters would be retained in the same region for a long time yet. This made it possible for the fishing-season staff to transfer floating equipment, tackle and fishermen from the northern regions to the southern.

The hydrologists' forecast that unfavorable fishing conditions would obtain in Aniva Bay at the end of April and beginning of May also proved to be completely correct. The forecast was made on the basis of a careful study of this region's regime from the steamer "Explorer".

Together with hydrologists, the hydrometeorological bureau personnel included experimental synopticians, Senior Scientific Workers Usmanov and Gurov of the Central Forecasting Institute, Synoptician Kalendov of the Vladivostok UGMS, and Synopticians Abibulayev and Rayeva of the Sakhalin-Kuril UGMS, who guaranteed the high quality of forecasts and storm warnings. The co-workers of the oceanographic group worked in close contact with the synoptical group, which lightened to a considerable degree the task of physical explanation of the processes occurring in the sea.

Leading up to the results of the first experiment in service to the fish industry through the aid of "excursion" groups, it is

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essential to note the following.

During the five years which have elapsed since the moment of reunion of south Sakhalin it has been impossible to study the regime of the waters which wash the shores of the islands with sufficient completeness. The research conducted by the Japanese does not provide a basis for solution of a series of problems put forward by our practice. It is therefore altogether essential to conduct, together with the hydrological investigations which satisfy the current demands of industry, observations at sea which will allow us to study the formatory mechanism of the hydrological regime of the sea and on the basis of these investigations to develop methods of hydrological forecasting and, first of all, of forecasting water temperature.

The director of the hydrological group, Istoshin, while participating directly in the spring fishing season service, was at the same time able to organize additional research directed toward clarification of the general regularities of the hydrological regime in South Sakhalin waters. This research provided extremely valuable material contributing to the further improvement of service to the fishing industry in the future.

As a consequence of the great work conducted by the group of experimental oceanologists in conjunction with young specialists of the local administrations, the latter were given the opportunity to continue the research at sea independently and provided additional extremely important observational materials on the fishing region. Analysis of these materials made it possible to approach service to the fishing industry with great confidence.

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Since the southwest Sakhalin region has been poorly studied hydrologically, the work of hydrological forecasting cannot be raised to the proper level.

The complex study of the regime accomplished jointly by the scientific institutes of the Ministry of Fishing Industry and Hydrometeorological Service will afford in the very near future considerable improvement in the methods of all hydrometeorological forecasts, and this will tell in the most beneficial manner upon the industry in Sakhalin waters.

The next question which must be dwelt upon is that of utilization of the experiment of hydrometeorological fishing season service on Sakhalin in 1949. This experiment showed that well conducted service, especially synoptic, and above all storm-warning service, brings great benefit to the industry. Altogether naturally the idea arose of attaching a forecasting service at the fishing locale itself. However, neither at the Ministry of Fishing Industry nor at the Main Administration of the Hydrometeorological Service did the idea arise of the necessity for rendering, even in the future, qualified help for the local forecasting nucleus, which is still far from strong. It stands to reason that the leaving of local workers to themselves will not further the strengthening of the work experience achieved in service to the fishing industry.

Another example of special service is the organization of works for hydrometeorological security of petroleum operations on the Caspian Sea.

It is known that the ice conditions on the Caspian Sea in the winter of 1950 were of an unusual character and were extreme in

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their consequences.

Low air temperatures in January and the beginning of February brought about increased iciness, expressed not only in increase of power (thickness) of the ice in comparison with the norm, but also in its extreme expansion in area.

On account of the heavy ice conditions on the Caspian Sea and the dangers arising for marine petroleum installations, the necessity for performing special hydrometeorological service arose.

Daily information on the hydrometeorological situation and advance warning of possible threat to the petroleum installations in connection with changes in the ice conditions were organized.

The observational materials of winter 1950 on the Caspian Sea made it possible to study the conditions of formation and drift of ice in the littoral zone of the western shore as functions of hydrometeorological factors. Analysis of the observational materials, taking into account the synoptic chart, made it possible to establish with what winds unfavorable ice conditions, threatening to installations, are created, and what is the influence of current and wind on the drifting of ice.

On the basis of careful analysis of these materials ice pressure was foretold.

During the period from 9 January to 18 March, 24 aerial and two marine surveys were conducted, which made it possible to draw conclusions about the amount of ice, its distribution in area, and its drift.

On 8 and 13 March strategic aerial ice surveys were conducted

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for the purpose of finding the edges of the floating and stationary ice over the entire area of the northern Caspian. These surveys made it possible to determine the probability of appearance of drifting ice at the western shore, which was especially important for the given period of time inasmuch as drifting ice from the northern regions presented a serious threat to installations there.

It should be especially emphasized that the aerial ice surveys were of a purposeful nature and were conducted at a time which made it possible to expose the changes in ice conditions as functions of various weather conditions. Therefore the materials obtained are especially valuable, making possible determination of the dependence of ice drift on the force and direction of the wind.

It is essential to note that operative work conducted centrally also aided the successful performance of hydrometeorological service to the petroleum industry.

The Marine Forecasting Division of the Central Forecasting Institute in turn organized the collection, analysis and control of all incoming information. Graphic synopses and ice charts were compiled daily for the Ministry of Petroleum Industry and certain other interested organizations. In addition, constant telephone connections were maintained with supervisory workers at the Ministry.

In the Long-Range Weather Forecasting Division of the Central Forecasting Institute, Synoptician Averbukh systematically compiled three-day weather forecasts for the Caspian Sea.

Coordination of the work of the hydrological group with that of the Information Section of the Marine Forecasting Division of the Central Forecasting Institute made it possible to deliver information

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clearly and without unnecessary difficulties.

During the time of the hydrological group's work, two forecasts were compiled in the Marine Forecasting Division and transmitted to the Ministry of Petroleum Industry: the first concerned the appearance of local ice in the petroleum operations region on 14 January, and the second, the approach on 8 - 9 March of returning ice at the time of the spring ice breakup. Both forecasts proved correct.

The petroleum industry's work in hydrometeorological service on the Caspian Sea in winter 1950 made it possible to present the interested organizations with constant and complete information on the state of the ice and the weather, thus forestalling possible danger to the installations.

An extremely useful and essential part of the informational work was represented by the data of the aerial ice surveys.

It is essential that the experience acquired in making aerial ice surveys be taken into account and utilized in the future.

The direct participation of co-workers of the Marine Forecasting Division in the surveys, in particular, Technician Mileyko, who had had adequate experience in the surveying of ice, affected to a considerable extent the quality of the surveys which were conducted. His transmission of his experience to the workers of the local organs of the Hydrometeorological Service who were taking part in the surveys is deserving of merit.

The cooperative work of the Central Forecasting Institute and the hydrological group which went out into the field also proved to

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be extremely effective.

All the participants in the spring fishing season service in the Sakhalin region and in petroleum industry service on the Caspian Sea were promoted by the higher organizations for their well-conducted field work.

In conclusion, one may say that the quality of operational service to separate branches of the national economy rises considerably when the service is of a specialized character and is conducted directly toward concrete objectives with the recruiting of workers from the center. Therefore the first experiment in specialized service carried out by the Marine Forecasting Division of the Central Forecasting Institute in 1949 - 1950 must be consolidated and incorporated into future practice.

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SHORT REPORTS AND ARTICLES

ACCURACY OF HUMIDITY MEASUREMENT BY AIRPLANE METEOROGRAPH

Ye.S. Selezneva

The shortcomings of humidity measurement with hair receivers are well-known. They are especially strongly expressed in aerological soundings in particular, even in the most reliable of them -- airplane ascents. Although one may depend upon obtaining the relatively regular humidity cycle with its monotonous changes by aerological soundings, when there are sharp changes and microfluctuations the inertia of the apparatus distorts the data very substantially.

This problem confronts us with full acuteness in the study of cumulus clouds. It is extremely important to obtain reliable values of the humidity in different parts of the cumulus cloud, but an airplane (even the low-speed PO-2) slips through such clouds in a fraction of a minute, and the inertia meteorograph does not have time to register the humidity of the traversed cloud. Moreover, the degree of "underexposure" of the instrument and the magnitude of error remain unknown. The attempt to clear up this question on the basis of former hygrometer research gave no decisive results: hair studies have usually been conducted in the conditions at the earth's surface and the results have been formulated with application to stationary apparatus. In these works it is pointed out that long exposure of the hair hygrometers is necessary in the observations, since their readings even under favorable conditions fully correspond to the surrounding medium only after a ten-minute exposure, and under unfavorable conditions (low humidities, low

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temperatures) this time increases sharply. In very low temperature conditions, as we know, the hair ceases to react to humidity variation.

All this is extremely disadvantageous for aerological soundings: even ten minutes is a magnitude excessively large for aerological purposes.

With reference to our particular problem -- soundings in summer cumulus clouds -- the external conditions were favorable: the measurements were basically concerned with the realm of positive temperatures, and the humidity of the air in the cloud zone amounted to from 60-70 to 90-100 percent. But exposure of the instrument for several minutes within the cloud was out of the question. However, full correspondence of the meteorograph readings with the actual humidity of the medium is not absolutely necessary -- for practical purposes an accuracy of 2-5 percent is sufficient. For clarification of the necessary exposure of the instrument in relation to the desired accuracy, one should know the coefficient of inertia.

Nearly 40 years ago Kleinschmidt concerned himself with determination of the inertia coefficient of the hair receivers of aerological instruments (sounding balloons); it is to his work chiefly that the literature and handbooks refer [1]. For determination of the inertia coefficient of a hair, Kleinschmidt [2], by analogy with thermal receivers, applied the equation:

$$f_{actual} = f + k \frac{df}{dt}$$

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where f is the relative humidity according to the hygrometer reading, factual is the actual humidity of the air, τ is the time, and k is the hygrometer's coefficient of inertia.

In view of the variability of magnitude k for different hair receivers and for different conditions of the medium, the value of f_{actual} obtained by Kleinschmidt cannot be applied to our soundings. It seemed expedient to examine this problem anew with application to the meteorograph accepted by us (SM-43) and to try to find the value of coefficient k in flight conditions. Kleinschmidt indicates that the velocity of ventilation exerts no influence on the instrument's readings and its inertia, but he cites no factual data for airplane velocities.

The soundings of cumulus clouds which were conducted yielded data for certain conclusions on this methodological question. In many cases in our soundings the airplane flew horizontally, passing through the cloud. The moments of entry into the clouds or exit from them were registered on the meteorogram with the help of a contact device. The marks on the meteorograms first of all indicated that the apparatus reacted at once to entry into and exit from the clouds, registering a sharp change in humidity; no time lag was discovered in the break in the curve. This is certainly a positive characteristic of the hair.

On the basis of the indicated horizontal airplane flights we also succeeded in estimating the inertia coefficient of meteorograph SM-43's moisture receiver. It was assumed that the speed of change of the meteorograph reading is proportional to the difference between its readings and the actual value of the measured

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humidity of the medium; that is, df/dt is proportional to the difference:

$$\Delta f = f_{actual} - f$$

The complication consisted in the fact that in flight conditions one could not accurately determine the humidity and therefore did not know f_{actual}. To solve this problem, cases of cloud soundings were selected when one may with great certainty accept the humidity in the cloud as 100 percent (the apparatus shows 95-98 percent after a stay of 30-40 seconds within the cloud). Then f_{actual} becomes the determined magnitude:

$$f_{actual} = f_{cloud} = 100 \text{ percent.}$$

The initial reading of the meteorograph, $f_{initial}$, for given flight conditions may correspond to the humidity of the medium -- in our case usually to the extra-cloud space, in which a greater part of the flight is spent than in clouds.

Then, applying the hypothesis expressed above, we may write:

$$\frac{df}{dt} = \alpha (f_{cloud} - f) \qquad (1)$$

(f represents meteorograph readings) or

$$dt = k \frac{df}{f_{cloud} - f},$$

where $k = \frac{1}{\alpha}$.

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Let us integrate this expression from the initial moment of time $\tau = 0$ and $f = f_{init'l}$ to time τ and f_τ:

$$\int_0^\tau d\tau = k \int_{f_{init'l}}^{f_\tau} \frac{df}{f_{cloud} - f}, \tag{2}$$

$$\tau = k \ln \frac{f_{cloud} - f_{init'l}}{f_{cloud} - f_\tau} = k \ln \frac{\Delta_o f}{\Delta_\tau f},$$

where $\Delta_o f$ is the initial difference between the humidity in the cloud and that in the extra-cloud space and $\Delta_\tau f$ is the difference between the instrument reading and f_{cloud} during time τ.

Consequently,

$$k = \frac{\tau}{\ln \frac{\Delta_o f}{\Delta_\tau f}}. \tag{3}$$

τ is determined by meteorogram.

Using the described procedure we find that for a series of cases, according to formula (3), the value $k \simeq 50$ seconds.

It was desirable to check this result by a specially

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conducted experiment. In particular, we were obliged to make the determination of τ more precise, since with the usual two-hour revolution of the drum small values of τ (30-60 seconds) were coarsely determined. A more detailed recording of humidity might also show the nature of variation of Δf in time and confirm the dependence of k on $\ln \Delta f$.

In this connection supplementary meteorograph research was conducted in laboratory conditions. In order to obtain conditions analagous to the entrance of the instrument into a cloud and its exit from it, a meteorograph with humidity set at about 50 percent was transferred into a hygrochamber in which the humidity was maintained at about 96-97 percent and then was taken out of the hygrochamber and transferred into the same room where the humidity was 50 percent. Successive readings of the position of the humidity meteorograph pen during 30 seconds made it possible to construct a curve of the variation of f (according to the instrument) or of the difference $\Delta f = f_{final} - f_{preceding}$ as a function of time (Figure 1). The logarithmic nature of the curve Δf is clear from the graph and is confirmed by its structure, in the form of a straight line, in the coordinates (τ , log Δf).

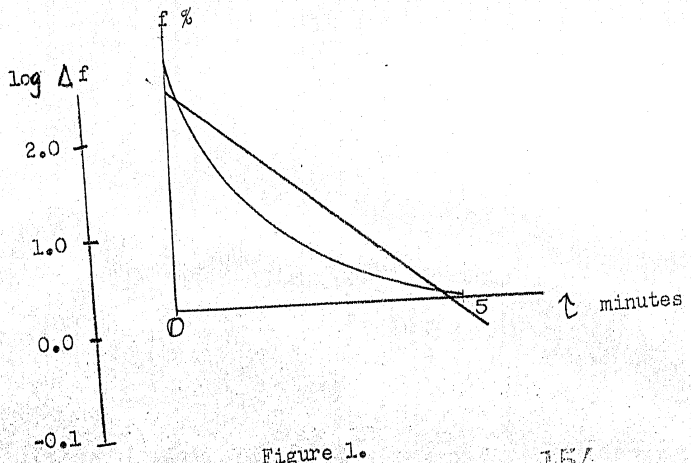

Figure 1.

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The values of coefficient k obtained in laboratory conditions were different -- higher -- than those obtained by processing the results of airplane soundings. This is explained by the different experimental conditions: a different value of $f_{init'l}$ and $\Delta_o f$ (in airplane soundings $\Delta_o f$ = 20-25 percent and in the laboratory, 50 percent), the absence of ventilation in the hygrochamber and the generally different conditions of the instrument's work in the laboratory.

The obtained values of k are not general and must be determined for each meteorograph in relation to the meteorological conditions.

In spite of the relativity of the estimates thus produced, they are undoubtedly useful both for clarification of the reliability of the results of soundings and for fixing sounding conditions. Thus, on the basis of the obtained value $k \cong 50$ seconds, with the differences $\Delta f = f_{cloud} - f_{extra\text{-}cloud}$ usually encountered by us, for determination of f_{cloud} with an accuracy of $\sim$ 2 percent, that is, for a tenfold decrease of $\Delta_o f$ initial, the meteorograph should be kept in the cloud for a time $\tau = 2.3k$ or $\tau = 115$ seconds $\sim$ 2 minutes. Allowing a lowering of the accuracy of determination of f_{cloud} to 5 percent, that is, to $\frac{\Delta_o f}{4}$, an exposure of more than a minute (70 seconds) is still required.

In our soundings the airplane was in the cumulus cloud 30-50 seconds, that is $\Delta_o f$ could decrease only 2-2.5 times, and therefore the accuracy in determination of f_{cloud} did not exceed 10 percent.

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Knowing coefficient k, one may also solve another problem: what is f_{actual} if during τ seconds the meteorograph records a humidity f_{τ} in the cloud?

From equation (2) we easily find:

$$f_{actual} = \frac{f_{init'l} - f_{\tau} e^{\tau/k}}{1 - e^{\tau/k}}. \qquad (4)$$

Thus in each concrete case f_{actual} may be determined, and in particular a question may be raised as to the reliability of values $f_{cloud} < 100$ percent obtained in soundings.

For example, let the meteorograph after 30 seconds of flight within a cloud register a humidity of 80 percent, and let $f_{initial}$, before entry into the cloud, equal 65 percent. Then by formula (4) we find that $f_{actual} = 98.5$ percent, that is, for practical purposes, $f_{cloud} = 100$ percent. If the meteorograph showed the same humidity for 50 seconds, then f_{cloud} would be only 89 percent. Therefore it is very important in soundings to note the time of the airplane's flight in the clouds. Without indication of this time, data on humidity in clouds has no value at all.

A more general solution of the problem of meteorograph inertia in the humidity measurement connection may be obtained if one takes into account the variation of humidity of the medium itself; for example, the change of humidity in clouds from the

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periphery to the central regions, and the general gradual change of humidity with altitude in ordinary vertical soundings.

REFERENCES

1. Kedrolivanskiy, V. N., Meteorological Instruments, 1948.

2. Kleinschmidt, Ye., Fenchtigkeitsmessungen bei Registrierballonaufstiegen. Beitr. z. Phys. fr. Atm. Bdz, H. 3, 1908.

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THE MAGNITUDE OF ERROR IN DETERMINATION OF THE ALTITUDE OF CLOUDS BY THE VISUAL METHOD

N. A. Karunin

Determination of the altitudes of the lower boundaries of clouds in the basic network of meteorological stations depends upon a number of so-called visual observations.

Visual observations cannot be accurate and objective. One may say beforehand that estimates of the altitude of one and the same cloud phenomenon performed by different observers will have different values. Just what the accuracy of visual determinations is and how great the divergence from the true altitude may be has not been settled in the literature.

The Moscow Administration of the Hydrometeorological Service, which was organized at the time of the construction of the Palace of the Soviets, interested itself in this question. In the period from 1 January to 28 April 1939 it conducted a series of visual and pilot-balloon determinations of cloud altitutdes. In our opinion the obtained results of comparison have a certain methodological interest and allow one to come to preliminary conclusions concerning the nature of errors in determination of cloudiness altitudes.

Cloud altitudes were determined at the times of pilot-balloon (base) observations, that is, at 8, 14 and 18 hours. All the observations of cloudiness during the above-indicated period were directed toward the lower stratum and by number of cases were distributed in the following manner:

Sc	St	FrSt	Ns
18	18	10	5

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Several observers took part in the aerological and visual observations of cloudiness. The total number of individual determinations amounted to 152. The visual observations of cloud altitude preceded the observations by pilot balloon.

For the subsequent analysis of the results of cloud altitude determination by these methods the differences in the altitudes obtained by the two means were computed. For this purpose the altitude determined by pilot balloon was conditionally accepted as the true altitude.

If the altitude of cloudiness obtained by the visual method was less than that obtained by pilot balloon, their difference had a plus sign.

Having made the above general remarks, let us pass on to consideration of the dependence of the absolute error in determination of cloudiness altitude upon altitude. In Table 1 the factual data of observation which characterize this dependency are cited.

[see following page for Table 1]

From these data the following things are evident:

1. The magnitude of average absolute error does not remain constant, but changes with increase of the true cloud altitude. It apparently has a tendency to decrease up to a certain altitude, above which an increase is registered.

The relative average error changes comparatively little. On the average, errors of negative sign correspond to clouds with a lower-boundary altitude of 300-350 meters, and those of positive sign,

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TABLE 1

Errors in Determination of the Lower Boundary of Cloudiness by the Visual Method for Various Actual Altitudes of Cloudiness in Meters

Intervals of Actual Altitude of Clouds, Meters																			
from	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
to	0 [1]	50 [2]	100 [3]	150 [4]	200 [5]	250 [6]	300 [7]	350 [8]	400 [9]	450 [10]	500 [11]	550 [12]	600 [13]	650 [14]	700 [15]	750 [16]	800 [17]	850 [18]	900 [19]	950 [20]
	--	--	-90	+30	+75	-35	+25	+125	+210	+85	+62	+130	-170	+120	+244	+400	+130	+695	--	+353
			-190	+30	+125	+15	+125	+75	-90	+135	+12	+230	-370	-30	+194	+300	+230	+570		+553
			-340	+30	+125	-35	+125	+175	+10	+185	-38		-70	+289	+144	+400	+130	+70		+178
			-67	-30	-50	-35	+20	+215	-182	+85	-88		+241	+339	+44	+300	+230	+270		+603
			+8	+50		-210	+20	+90	-82	+269	-61		+241	+339		+400	+450	+68		
			+33	+20		-10	-190	+40	-282	+194	+139		+123	+289		+350	+450			
				+20		-10	-240	+140	-182	+169	+139		+123	-137		+192	+350			
				-2		-310	+10		-77	+219	-61		-67	-37		+192	+550			
				+23		+90	-290		+23	-200	+70		+123			-8	+34			
				+98		-10	+50		-77	-100	-30					-8	-166			
				-100		-10	-50		+23	-100	+70						-187			
				-50			0		+222	0	+220						+13			
				-100					+122		+262						-187			

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	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]
				-125							+362									
				- 80							+262									
				- 30							+212									
Average	--	--	-108	-13	+69	-51	-33	+123	-28	+78	+96	+180	+19	+147	+157	+252	+156	+335	—	+422
% of Mean																				
Altitude	--	--	-86	-7	31	-19	-10	33	-7	16	18	31	3	22	22	33	19	38	—	43

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to clouds higher than this altitude.

In other words, the data cited show that, in the first place, low clouds are located with less absolute error than the higher ones; in the second place, with visual determination the altitude of low clouds (on the order of up to 300-350 meters) is given a value which is too high, and that of higher clouds (above 300-350 meters), on the contrary, a value too low.

The next question meriting attention concerns the errors in determination admitted by separate observers. In the given case the limited number of observations falling to the lot of each observer did not make it possible to link the errors made by separate observers with the true altitude of the clouds. Therefore the problem posed was analyzed extremely roughly. Certain conclusions were obtained on the basis of the 15-23 individual determinations made by each observer. The condition of the vision of five observers could be considered normal; the sixth observer was myopic, and did not use his spectacles in determining the cloud altitudes.

Shown in Table 2 in percentages is the number of cases with various magnitudes of error in determinations of cloud altitude admitted by each of the six observers. This table well illustrates the individual nature of visual determinations: some observers preeminently give the altitude as lower than the true, others give it higher. Attracting attention especially is the predominance of cases with too high estimates (positive differences) on the part of the sixth, near-sighted observer.

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TABLE 2

Number of Cases with Various Magnitudes of Error in Determination of

Observers	Magnitude of Errors, Meters: 350-400 -	300-350 -	250-300 -	200-250 -	150-200 -	100-150 -	50-100 -	0-50 -	0-50 +	50-100 +	100-150 +	150-200 +	200-250 +	250-300 +	300-350 +	350-400 +	400-450 +	450-500 +
I	--	--	--	--	7	--	13	13	27	13	--	7	13	--	--	7	--	--
II	5	4	--	--	--	--	4	9	13	9	13	--	13	4	4	4	4	--
III	--	--	5	--	--	--	--	17	17	11	17	6	11	6	5	--	--	--
IV	--	--	4	--	5	9	9	21	16	5	--	9	9	--	5	--	--	4
V	--	--	--	--	7	--	13	7	27	7	20	--	--	--	--	13	--	--
VI	--	--	--	4	23	4	23	5	9	--	9	--	5	5	--	5	--	--

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The Altitude of the Lower Boundary of Cloudiness by Various Observers (Percent)

Meters

500-550 +	550-600 +	600-650 +	650-700 +	700-750 +	750-800 +	800-850 +	850-900 +	900-950 +	950-1000 +	Total %	Number of Cases (%) Giving A Value of Cloud Altitude With an Accuracy of: ±100 meters	±200 meters
--	--	--	--	--	--	--	--	--	--	100	66	80
--	5	--	9	--	--	--	--	--	--	100	35	48
--	5	--	--	--	--	--	--	--	--	100	45	68
4	--	--	--	--	--	--	--	--	--	100	51	74
--	--	--	--	--	--	--	--	--	6	100	54	81
--	--	--	4	--	--	--	4	--	--	100	37	73
										Average:	48	71

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The data cited in the righthand part of Table 2 allow us to answer still another question, namely, what percent of visual determinations of cloud altitudes are made with errors not exceeding a certain set magnitude, for example 100 or 200 meters. The figures show that for individual observers the number of determinations with errors of 100 ranges from 35 to 66 percent, and with errors of 200 meters, from 48 to 81 percent. The averages for the six observers are 48 percent and 71 percent respectively.

The deviations, expressed in percentages of the number of determinations made by the individual observer, from the average number of observations for all the observers with magnitudes of error within the range 100 meters and 200 meters are as follows:

Range, Meters	Observers					
	I	II	III	IV	V	VI
100	-12	+13	+3	-3	-6	+11
200	-9	+23	+3	-3	-10	-2

As is apparent, the magnitudes of the deviations of the number of observations made by different observers and answering to one and the same limiting magnitude of error are comparatively small. Therefore, from the data cited above one may make the following conclusion as a first approximation for practical deliberation: in visual determination of the altitude of cloudiness (up to 1000 meters) 48 percent of determinations yield an error within the range 100 meters, and 71 percent, within the range 200 meters.

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It must be immediately remarked that these results were obtained in conditions where the observational personnel had the possibility of systematically acquiring experience in visual determination of cloudiness altitude in the presence of parallel pilot-balloon observations. In ordinary meteorological station conditions, where the observers do not have such experience, the results of determinations must be less accurate.

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CHRONICLE

TWENTIETH ANNIVERSARY OF THE MOSCOW HYDROMETEOROLOGICAL TECHNICAL SCHOOL

V. M. Sklyarov

This year the Moscow Hydrometeorological Technical School, the first hydrometeorological educational institute opened in the USSR, is 20 years old.

The Moscow Hydrometeorological Technical School was created in 1929-1930, years known in the history of our Fatherland as the period of the great change, denoting the large-scale progress of socialism in industry, the first serious progress in agriculture, the beginning of mass kolkhoz movements.

The development, tremendous in scale, of productive forces in conditions of a planned socialistic economy demanded of the Hydrometeorological Service USSR solutions of large and complicated problems directed toward improvement of hydrometeorological service to the branches of the national economy.

The Moscow Hydrometeorological Technical School Building

[Photo]

These problems could be successfully solved only with the presence of qualified hydrometeorological cadres.

Although up to the time of the October Revolution there were great hydrometeorological scientists with world-famous names in Russia, practical workers were extraordinarily few.

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After the revolution, the creation of a broad system of courses played a considerable part in guaranteeing the country hydrometeorological cadres; however, it could not finally solve the problem of preparation of high-quality specialists, the absence of which became in the course of time an extremely large obstacle to the course of development of the hydrometeorological service.

Thanks to the care of the Party and the Soviet Government, who paid constant attention to the development of the hydrometeorological service in our country, the problem of preparation of qualified hydrometeorological cadres was successfully solved.

The first Hydrometeorological Institute was organized in 1930 on the grounds of the Geophysics Division of the Moscow State University. A year before this, preparation of hydrometeorological specialists of intermediate qualifications had begun in the Saltykov Nine-Year Trade School, which was reorganized by governmental decree into the Moscow Hydrometeorological Technical School and subsequently moved to Kuchino Station, where it was presented with a fine building.

Since that time the network of hydrometeorological educational institutions has grown immeasurably. At the present time hydrometeorological specialists are prepared at more than twenty higher and intermediate educational institutions and, in addition, by a large number of constantly offered and short-term courses.

However, even now the Moscow Hydrometeorological Technical School occupies a peculiar position in the system of preparation of

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hydrometeorological cadres, being the largest intermediate technical educational institution of the Hydrometeorological Service. It is laid out on a well equipped base -- with two training stations (hydrological and meteorological), 13 study rooms and laboratories for general-educational and special disciplines, a training hydrometeorological forecasting bureau, an apparatus check-up bureau and a large library, numbering over 36,000 volumes.

Gathered in the technical school is a strong staff of qualified instructors who have great experience in industrial and pedagogical work. The Technical School's staff toils persistently to give the country not only technically literate specialists, but also active builders of communistic society armed with the advanced theory of Marxism-Leninism. The Technical School's best instructors are T. N. Fedotova, A. V. Kunits, M. V. Matveyev, M. N. Zhernova, V. V. Vetukhnovskaya, A. G. Biserov, K. M. Komnatnaya, Ye. A. Sokolov, and others.

During the 20 years of its work the Technical School has prepared over 1500 hydrometeorological specialists of intermediate qualification, a large number of whom are working successfully in organs of the Hydrometeorological Service USSR.

A considerable number of alumni of the Moscow Hydrometeorological Technical School occupy responsible posts in the Hydrometeorological Service system, among them: V. I. Korzun -- Chief of Administration of the network of observational hydrometeorological stations GUGMS [Main Administration, Hydrometeorological Service], I. M. Zhuyko -- Chief of the Omsk Administration of the Hydrometeorological Service, P. A. Sokolov, Department Chief GUGMS,

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V. D. Marushchenko -- Assistant Department Chief GUGMS,

A. S. Sukhanov -- Acting Chief of the Yakutsk Administration of the Hydrometeorological Service and many others.

The Technical School's student body is growing from year to year and at the present time has reached about 500. In addition, over 400 people, the overwhelming majority of whom are workers in the Hydrometeorological Service system, are receiving instructions in the school's correspondence-course division.

In 1950 construction of a dormitory for the Technical School students was begun.

The association of workers and students at the Moscow Hydrometeorological Technical School are exerting all their efforts in order to greet the 20-year jubilee of the Technical School with high standards in science-educational work, with timely and solid preparation for the new 1950-1951 school year.

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WORK IN CENTRAL COURSES

F. P. Lisachenko

The Main Administration of the Hydrometeorological Service attached to the Soviet of Ministers USSR has organized central courses this year for raising the qualifications of supervisory workers in the Hydrometeorological Service.

The aim of the courses is to raise the level of economic and special knowledge of these cadres. The courses will further the more correct solution of a series of productional, operational and economical problems by local supervisory workers of the Hydrometeorological Service.

The educational plan in the courses is so constructed that together with study of special disciplines, particular attention is directed toward socio-economic disciplines, whose content is subordinated to the fundamental idea of elucidating the principles and practical problems of the Bolshevist style of leadership.

The first presentation of central courses began on 4 April and finished 29 June 1950; 24 people in all were taught (among them 9 UGMS Chiefs, 7 Acting UGMS Chiefs, 4 Department Chiefs and 4 GMB Chiefs).

A highly qualified staff of instructors has been selected for the courses, instructors who know how, not only to set forth materials well, but also to organize (under conditions where the auditors have large daily study loads) homework materials and the execution of a series of practical projects by the students. The

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following instructors should be specially mentioned here: M. Ya. Rayskaya and M. I. Chistyakov, who give the course "Political Economy of Socialism", S. Ya. Osherov ("Principles of Soviet Government and A. A. Duginov ("Principles of Soviet Economics and the Practice of Leadership in the National Economy USSR").

One cannot but note the serious attitude the students show throughout the instruction period toward study of the subject being given. A good and operative course service by the economical department GUGMS also contributes to the regular work.

The final examinations showed good progress. Excellent and good ratings were received by 80.6 percent of the auditors.

Analysis of the work of the courses (the first presentation) and the total assemblage of auditors allows one to make the following general conclusions:

(a) instruction at central courses reveals substantial gaps in the auditors' knowledge. The auditors had not noticed these gaps until the courses and naturally had applied no proper measures to liquidate them;

(b) the knowledge obtained by each supervisor at the courses will promote future independent work on his part toward raising his own qualifications;

(c) the central courses have allowed each auditor to be studied more deeply and from all sides in his individuality. This circumstance enables the Cadres Administration GUGMS more quickly to solve the problem of advancement of this or that worker to

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another, more responsible job.

There were certain essential faults in the work of the central courses which it is essential to eliminate in the future. An important moment in the organization of the courses was the selection of a homogeneous body of auditors. Unequal preparation of students would make it impossible to organize the educational (program) successfully so that the whole group might make good progress. Experience in the work of the first run of central courses shows that the educational plan and curriculum require re-examination in the directions of supplementing them somewhat, making them more precise and eliminating secondary minor questions which encumber the training process, and also decreasing the daily study load and introducing practical projects in specialized disciplines. The presentation of each independent subject must be entrusted to one instructor, renouncing the practice of bringing in several instructors for presentation of their own sections of the same course. Particular attention must be devoted in the future to seminar studies, which further good assimilation of materials.

The regular work of central courses in raising the qualifications of Hydrometeorological Service supervisory workers is a very important and essential matter.

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CRITICISM AND BIBLIOGRAPHY

A. A. BORISOV. Climatology. Gidrometeoizdat. Leningrad, 1949. (Accepted by the Cadres Administration GUGMS attached to the Soviet of Ministers USSR as a training manual for hydrometeorological technical schools).

When you take this book in hand and look through it rapidly it produces at first glance an altogether favorable impression. The book is small in size and -- a great virtue in a textbook -- contains many illustrations, which are executed satisfactorily enough. Examining the table of contents you see that, in spite of the book's small size, it includes all the basic problems of climatology. The order of presentation arouses no great objection either. You begin to check the annotations, confirming that "the book is a concise and at the same time extremely complete exposition of the elements of climatology", and you rejoice for the reader who is receiving a new training manual on his subject.

However, upon first acquaintance with the book's text a disappointment arises which grows ever stronger with each page and ultimately turns into vexation and occasionally into sheer indignation.

The book contains no idea at all, no general view of the presented subject. A great part of it represents nothing else but a mixture of extracts from other works on climatology, plucked out just as they are. Many chapters remind one sooner of a poor student's composition on an assigned theme than of a training manual. Nor are the chapters few where it is difficult to find a page on

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which there is no gross error, inconsistency, absurdity or else mere obscure and empty phrase.

The book's organic defect -- its unscrupulousness -- is disclosed at once, in the introduction, by the very statement of the basic question of what climate is. The author does not give what is essential for a textbook -- an accurate definition of the concept of climate. Instead of this, for a page and a half, eight different definitions of climate, belonging to a whole series of authors from Strabon to our own day, are "objectively" copied, among them some of which are completely useless and out-of-date. The reader must guess for himself which of them is best and how bad the rest are.

Moreover, confining himself to the truism that "climatology is the science of climate", the author says not a word about the interrelations between climate and weather; he does not even mention the fact that climatology is a branch of meteorology. It is similarly impossible to learn anything from A. A. Borisov's book about the various methods of studying climate characteristics, about their dialectical-historical development.

About the nature of that severe crisis which classical climatology lived through in the twenties of this century there is not a word in the book.

In the short historical outline of the development of climatology we find only an enumeration of certain facts, names, dates, titles of works and data on the gradual quantitative development of the meteorological station network.

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As for the author's own views on the methods and aims of climatology, they are unexpectedly disclosed in Chapter VII, which astonishes the reader in the very first line with the following extremely strange and completely inadmissable definition of the aims of climatological treatment: "The essence of climatological treatment consists of exposing various errors, correcting them and thus obtaining sound climatological materials".

Reading through this unambiguous definition one can only conclude that the aims of climatology consists in correcting the errors made in meteorological observations, and the whole difference between meteorology and climatology boils down to the fact that uncorrected and unchecked observations may be used in meteorology, but not in climatology.

The author further reinforces this ridiculous idea with a subsequent sentence explaining what climatological treatment consists of. It appears that its whole business is this introduction of corrections into the readings of instruments (?), technical inspection, critical review and compilation of yearbooks.

In general, the whole section of the book devoted to climatological treatment of meteorological observations is not satisfactory at all. About all the extremely diverse and long used or accepted practical methods of climatological treatment, completely essential in all-Union climate service practice, what is said is so little and incoherent, admitting so many tangles, errors and gaps, that it would have been better to write nothing at all.

Let us take apart this chapter, so important for technical

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schools, in detail. It consists of three sections. In the first of them general statements from the official "Instructions for Treatment of Meteorological Data and Compilation of Yearbooks" are repeated, which in a climatological textbook is unnecessary and out of place, since these statements concern organization, work methods and technical rules exposed in the appropriate instructions. In the following section the author expands for fourteen whole pages an exposition of rather specialized and essentially secondary questions concerning the nonuniformity of series of observations and reduction to a single period. In this he often mixes the second question with the first (page 187), considering it without any relation to the nature and causes of variability of average climatological magnitudes and giving the student no notion at all of climatic norms and anomalies. The author's argumentation on these questions is represented by a dozen examples unsystematically copied out of other books, badly cemented together with extremely sloppily written explanations wherein one encounters sentences which would be altogether unacceptable, even in a student composition, their illiteracy, as, for example (page 196): ". . .short station B, reduced to a long series (B), is equal to the average value of the element of long station A . . ." etc. On this same page the author goes so far as to say the following: "The purpose of reduction is to obtain long series of observations for stations which have observations for a short period"! Representation of the true purposes is here reduced to absurdity, for it is certainly impossible to transform a short series of observations into a long one by any reduction.

Only in the closing paragraph of this chapter does the

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author speak of the content of climatological treatment of separate factors, but even here we find only a haphazard collection of certain data, presented, as usual, unsystematically, foggily and with numerous gross errors.

Thus in connection with air temperature the author completely ignores both the means of calculation and the physical meaning of the various types of average and extreme characteristics of the yearly and daily cycle and of nonperiodic fluctuations of the temperature complex. He does not even mention them, but for some reason or other begins at once with the question of drawing isotherms on charts, then jumps to pressure, again returns to temperature, and inserts in Figure 61, as an example of a "histogram", the curve of the annual temperature cycle at some unknown point. But the caption under the diagram unexpectedly reads: "Number of days with average daily temperature above zero degrees, minus five degrees, plus five degrees"; the curve in the diagram matches it, in that it does not even correspond to the method for its own construction as exposed in the text.

The treatment of cloudiness data is allotted not more than 15 lines, the bulk of them filled with recommendations of an extremely dubious procedure for filling in insufficient observations of lower cloudiness, which is presented in such a way that nothing can be understood, for shown on the diagram are observations from Kazan' Station, while some two other stations are being discussed in the text. For explanation of the fundamental method of characterizing the annual and daily cycle of cloudiness, for explanation of the relations of these data with solar radiation, the author has no word.

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To treatment of humidity data six lines in all are devoted which can only lead one into error, since the author speaks only ofsome principle of prevailing values, and the methods of treatment of relative humidity are incorrectly expanded to absolute humidity also; concerning the very important data-processing problem -- the humidity deficit -- nothing is said in general.

Also completely omitted is climatalogical treatment of data on frequency of precipitation, fogs, cloud forms and other atmospheric phenomena.

In the section on wind one can find neither explanation nor examples of how various types of climatological wind roses are constructed, nor what their physical meanings and practical significance are. Only one very exceptional and rarely used case is cited. Determination of wind frequency is "explained" by the following completely unintelligible sentence: "In calculating the frequency of wind direction one takes the sum of the winds, usually for eight compass points, without including the number of calms". Not a word about calculation of resultant winds.

On page 203 the author cites the rule for division of winds from 16 compass points into 8, but calls this rule . . . the definition of prevailing wind direction according to Kaminskiy and Rubinshteyn. And so on and so on.

It is difficult to find a paragraph in which there are no absurdities.

The remaining chapters of the book are not much better. Everywhere the same unsrupulous method of copying or paraphrasing

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from other textbooks prevails, everywhere the same extreme carelessness (or lack of information?) of the author in the basic problems of meteorology is disclosed.

The chapter on radiational climate begins straightway with two gross errors in definition of the radiation balance (page 11). According to the author the radiation balance consists of: (1) the income of solar radiation, (2) albedo, (3) the effective eradiation of the earth's surface, (4) the contrary eradiation of the atmosphere.

As is obvious, the author in the first place considers it possible to lump together the magnitude of radiation with the abstract nondimensional coefficient of albedo and in the second place does not know that the contrary eradiation of the atmosphere is already included in the magnitude of effective eradiation of the underlying surface. The difference between effective and total eradiation in general is apparently unfamiliar to the author. It is therefore not surprising that he baffles the reader, informing him on page 16 that "the maximum radiation is equal to 0.284 calories/square centimeter minute" and on page 17, "the earth eradiates on the average 0.58 calories/square centimeter minute". Further on the question of eradiation and its magnitude is still more hopelessly tangled up. From what is said on pages 16 and 17 it is clearly evident that eradiation is least in the polar regions, but on page 105, in the description of the radiation regime of the USSR, the following is written: "eradiation is most considerable in the polar regions".

The nature of eradiation is defined on page 16 in the most

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improbable manner: "Eradiation or loss of heat proceeds by way of: (1) absorption by the atmosphere and (2) withdrawal of heat into the world space". It appears that eradiation proceeds by way of "absorption" and by way of "withdrawal". Who can understand this?!

In speaking of solar radiation the author everywhere refers to the angle complementary to the angle of incidence as the angle of incidence, this angle being capable, according to him, of taking even negative values (-23.5 degrees).

Further, the author explains the warming of the whole atmosphere (end of section 2 on page 14) not by radiational and convectional heat exchange from the earth's surface, but "...by advection (from where??) and vertical mixing of air layers".

Let us turn to Chapter II -- "Circulation Factors in Climate". Here the author helps himself to a sample from the famous "Climatology" by four authors under the editorship of Ye. S. Rubinshteyn. However, in the process of his creative work the author was carried away by the sample, borrowing from it everything that suited his taste; true, he did not copy everything, not every sentence, but with abridgments, omitting a series of important points and mixing up the diagrams that illustrate the text. And he has abridged, omitted and mixed without thinking -- the reader will definitely lose the meaning, seeing that the weather chart of 3 May is cited as an example of winter weather, and the weather chart for 28 November as an example of summer weather.

On page 22 the author explains the thermal difference between marine and continental climate, not mentioning the decisive

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significance of thermal conductivity, reducing it to "the unequal thermal capacity of water and dry land" which, in defiance of physical sense, he equates, not with the volumetric, but with the specific, heat capacity.

On page 26 the author has "flashed" his ignorance of the foundations of meteorology, explaing the genesis of convectional currents by the fact that "the lower layer becomes lighter than the upper ones".

Page 37 of this chapter begins with a sentence which has no relation either to the preceding text or to the diagram to which this sentence contains a reference.

On page 38 the author ascribes to a cold air mass "a stable vertical stratification".

In Chapter V -- "Climates of the USSR -- there stands out amid the other absurdities an intolerably distorted description of the position of the arctic front in winter in the territories of the USSR. On page 108 the author writes: "In the cold half of the year an arctic front, separating polar air from arctic, is distinguished in the extreme north of the Asiatic territory USSR. The arctic front disappears to the west in Novaya Zemlya rayon and to the east at the mouth of the Yana River".

All this completely contradicts what is observed in nature and also, certainly, what is shown on S. P. Khromov's maps, which are annexed to the book.

Included in this same chapter, on page 102, is another

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such "discovery" inserted by the author without any relation to the preceding text: "At the time of a cyclone the air temperature in winter may exceed the air temperature which accompanies an anticyclone by 8 to 10 percent". But who does not know that in actuality this difference often amounts to 20 to 30 degrees and more?

There are also many gross errors in the chapter on microclimate. Here it is reported that resistance and thermocouple thermometers are one and the same thing (page 49), that "for study of the daily cycle of meteorological factors aloft, radio masts (?) and pilot balloons are employed", etc.

The descriptions of the climates of particular zones and oblasts are better done than the others in the book. In those cases where the author does not attempt to explain and merely describes the climate one may find whole pages which are presented altogether understandably and do not include a single error.

However, the sum total of gaps, gross errors and contradictions included in the book exceed any "norms". The criticized work is a grievous example of book waste. In delivering this refuse into the world, author, editor and publisher are guilty in equal measure; their guilt is redoubled by the fact that this is not simply a bad scientific "treatise", but is a training manual, accepted for preparation of specialists by the All-Union Hydrometeorological Service. One remains puzzled as to how this book could receive the "permit to live" from the hands of the climatology specialists who looked it over?

V. S. Samoylenko

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